SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS

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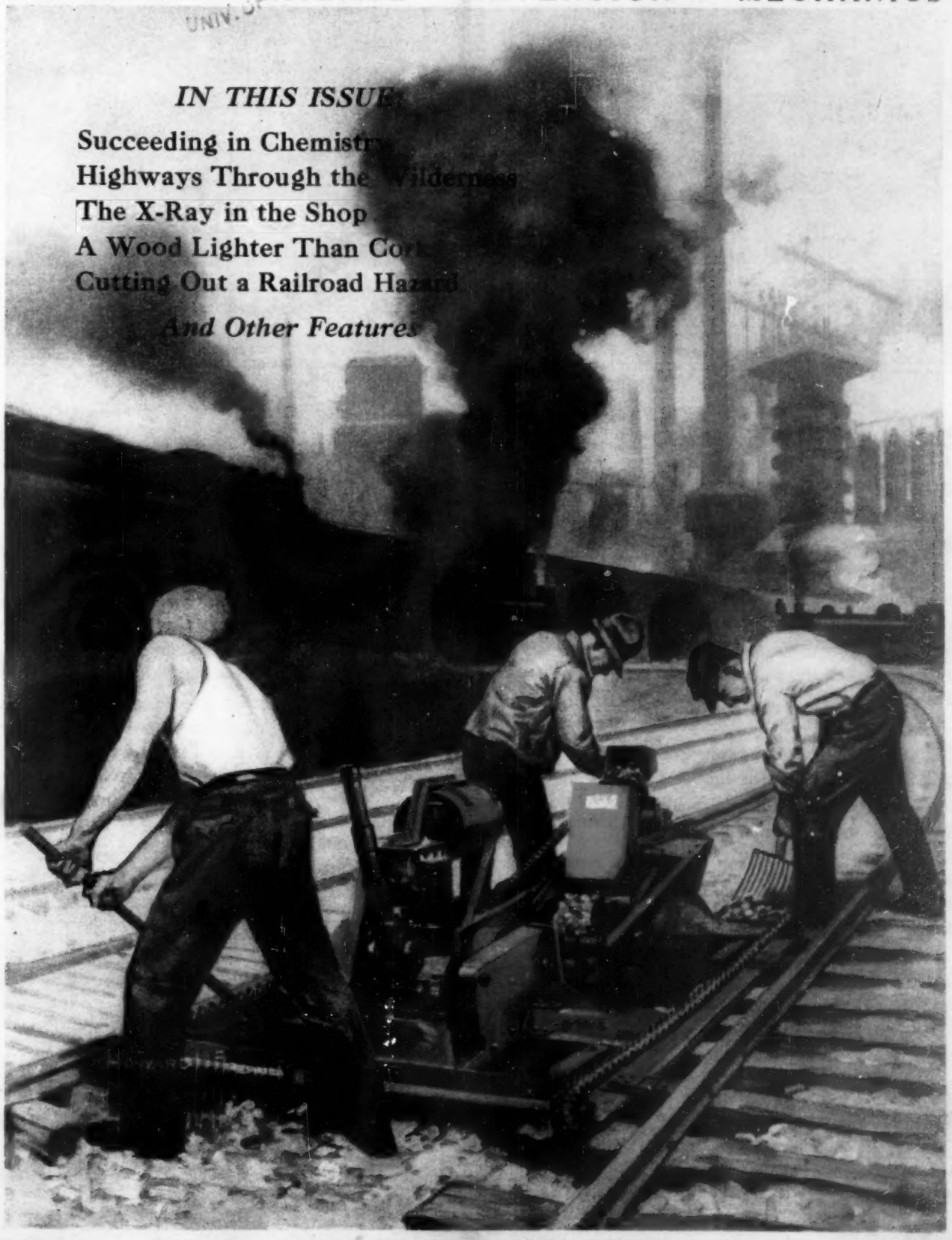

CLEANING RAILROAD BALLAST TO IMPROVE DRAINAGE—[See page 271]

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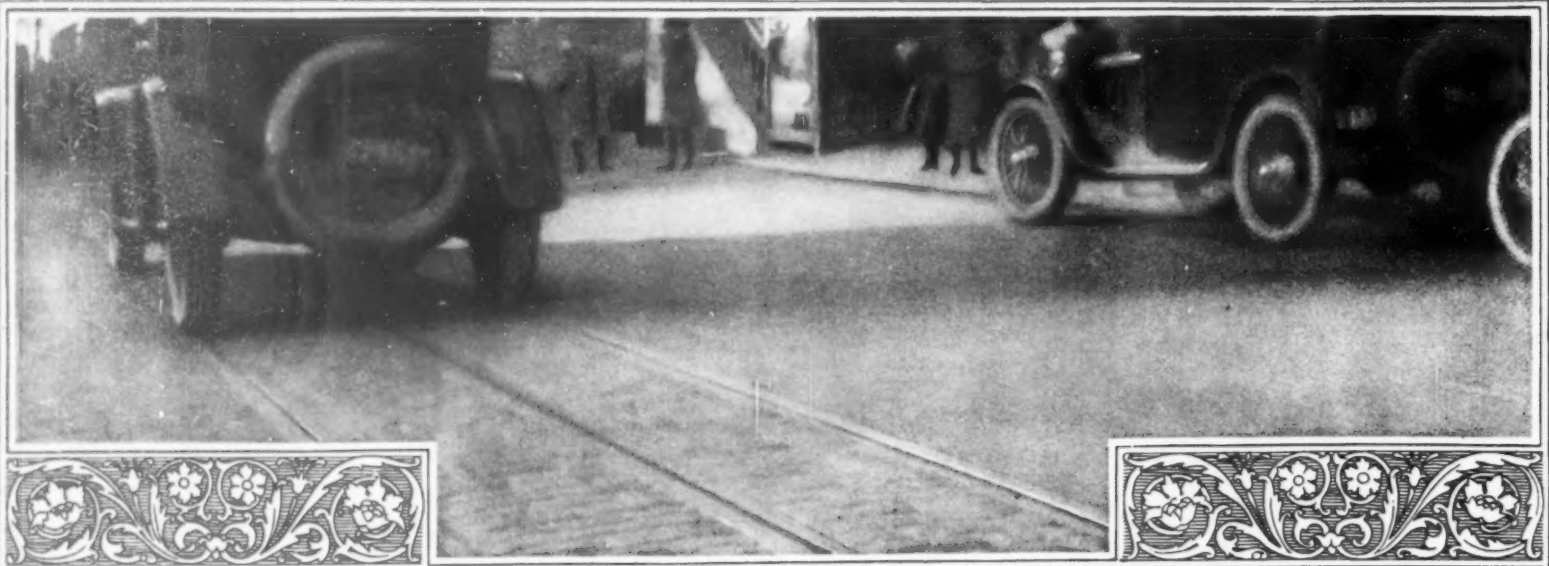
Go to a Legitimate Dealer and Get a Legitimate Tire



THIS year the American people will spend more than $900,000,000 for automobile tires.

Tires are one of the largest items in the motorist's budget.

The cost is making even careless buyers think and inquire.

And the more they inquire, the smaller will grow the influence of hearsay and the irresponsible tire dealer.

* * *

We have all met the man who takes his opinions ready-made.

He tells everything he knows. He knows more about every car than the man who made it, where to buy the cheapest truck—how to get the biggest bargain in tires.

He always arouses a certain amount of wonder in the unknowing. They never think to ask him where he gets his secrets.

Every time you drive your car along a track or a rut in a country road you are taking some life out of your tires.

Worn frogs and switches often cause small cuts, which are rapidly enlarged by the action of gravel and moisture. Ruts and track slots pinch the tire, wearing away the tread where their edges strike it.

It is well to avoid such places as much as possible.

"Somebody says" and "everybody does" are responsible for more wrong impressions about tires than anything else you can think of.

It is on the people who come under the influences of these phrases that the irresponsible dealer thrives.

* * *

You generally find him with the name of a standard tire displayed in his windows to give an impression of quality.

But when you get inside the first thing he begins to talk about is price and substitution.

What the thoughtful motorist is looking for today is *better* tires.

He goes to a legitimate dealer and gets a legitimate tire.

The *quality* idea—the idea of a quality tire, of a dealer who believes in quality—is commanding a greater respect from a larger portion of the motoring public all the time.

It is the idea on which the United States Rubber Company was founded—on which it has staked a greater investment than any other rubber organization in the world.

Build a *tire* that will *do more, a better tire than was built before,* and you are sure of a large and loyal following.

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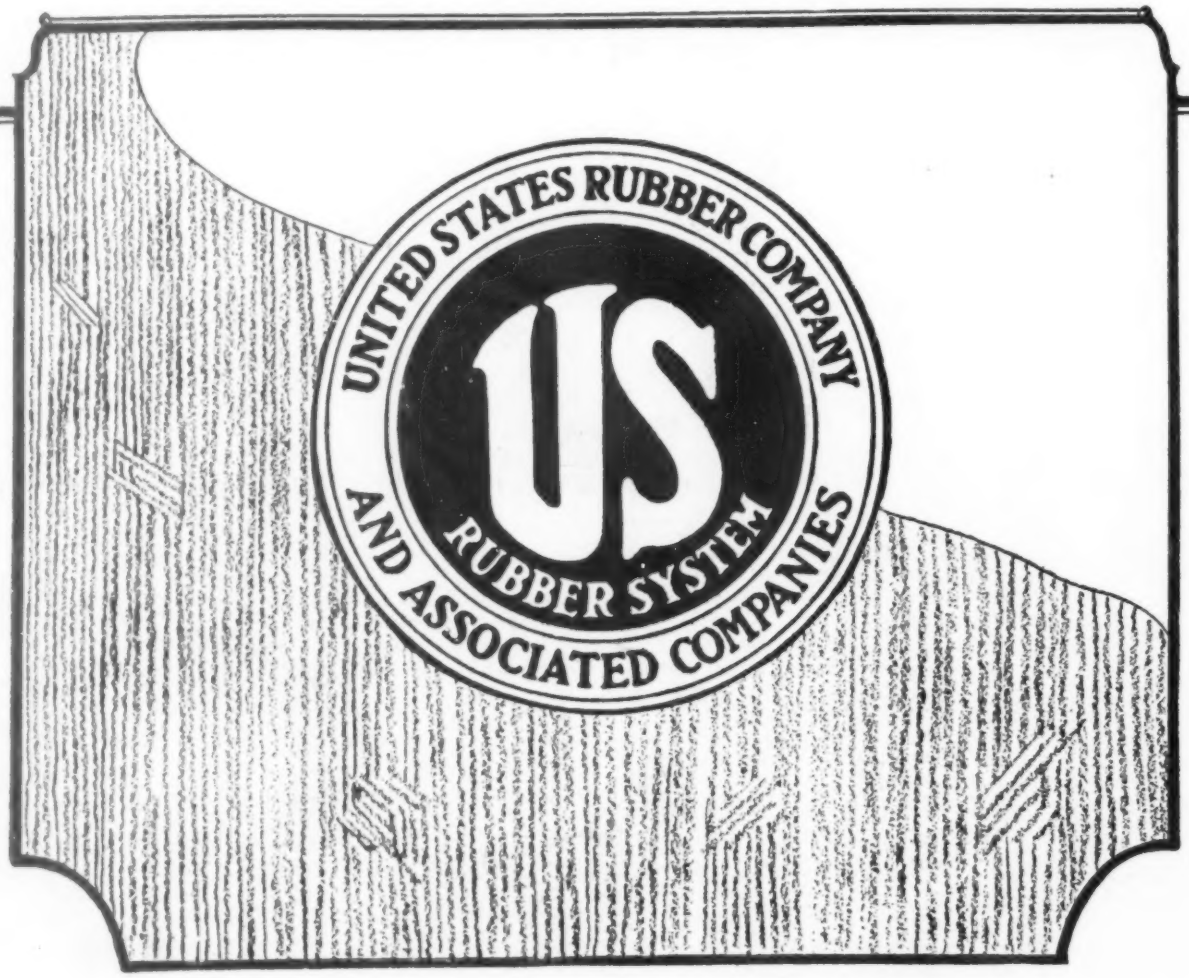

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There is a tested type of United States Packing to meet practically every mechanical need. Our engineers are at your service to aid you in determining the most suitable style or brand to meet each of your requirements. Simplify your packing problems by specifying United States Packings.

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SEVENTY-SIXTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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Lightening the Stevedore's Load

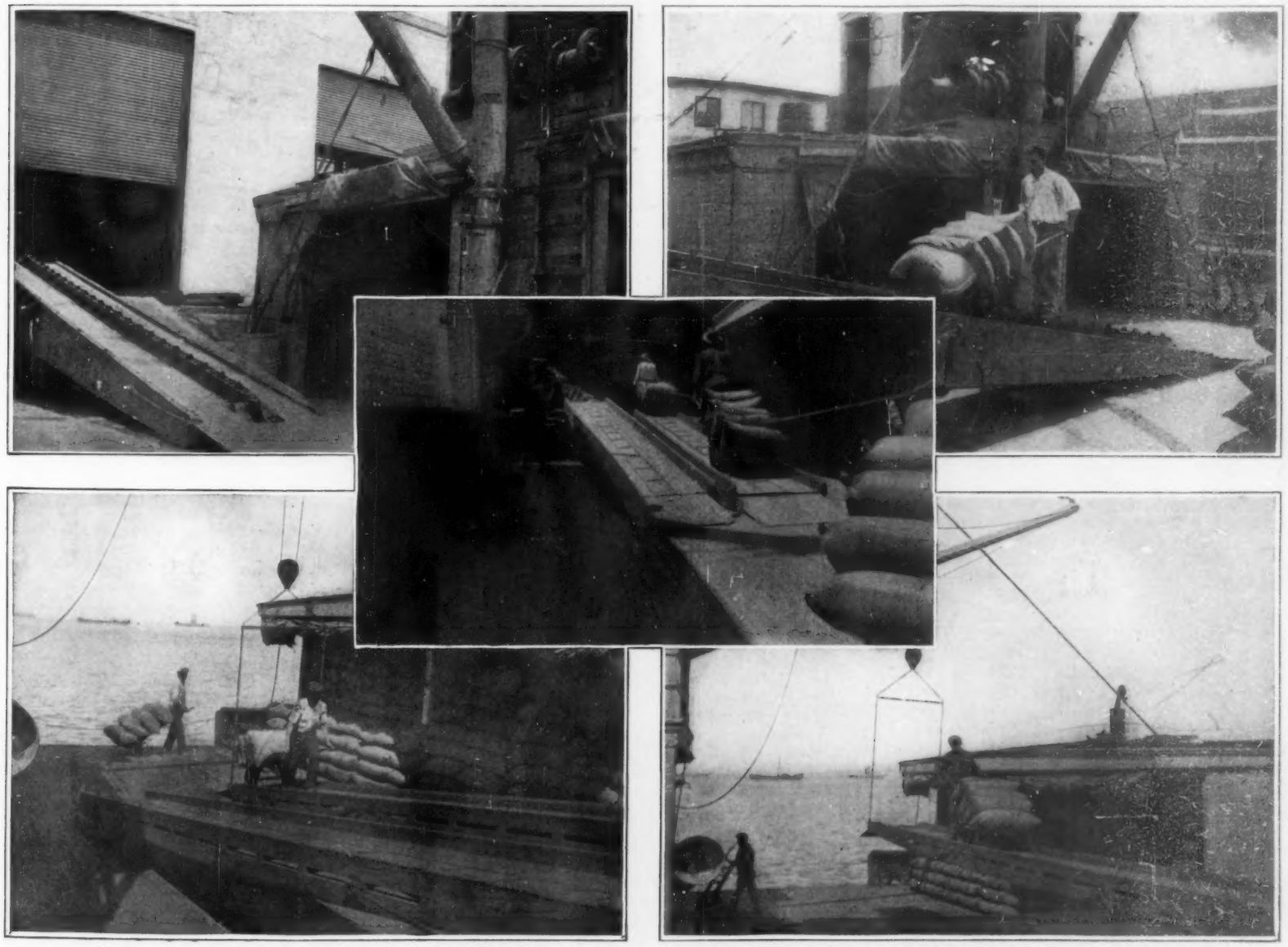
By C. W. Geiger

THE old method of handling bags of grain for transfer to and from ships, illustrated in the center view of our group, was a laborious process indeed. It involved the loading of the sacks, by hand, on trucks; and the pulling or pushing of these trucks by brute strength up whatever incline the gang-plank happened to present. If this incline were a downward one, the worker got no benefit from this, as he had to work just as hard to offset the constantly accelerating pull of gravity as he would have worked in elevating his load against that pull. This operation, from start to finish, required the intensive and laborious toil of the strongest men. It was slow and expensive. So we need not be at all surprised to learn that it has been replaced by a method which utilizes mechanical power to the limit.

The key to the new method lies in the slung gang-plank, illustrated in the two lower photographs. This gang-plank stands in the normal position, quite like its unflexible predecessor, while the stevedore wheels his loaded truck on to it. But then the machinery comes into play, and the outer end of the gang-plank, in its sling, is elevated until it stands just a wee bit above the level of the deck to which the load is to be delivered. Then the stevedore wheels his truck along the plank and off at the deck end, with a minimum of labor and a maximum assistance from gravity—the angle is made just right, so that he gets this help without having to hold the truck back against an excessive downward pull. The plank is raised by chains and cable attached to a steam hoist.

So much for the slung gang-plank, working by itself. But it no longer works by itself; a novel type of electric conveyor has been installed with it in San Francisco for the purpose of still further lightening and speeding up the task of the man behind the truck. This conveyor consists of a single chain installed in the center of the truck incline, and equipped with a number of pushers. The hand-truck is run on to the incline in the old way; but the pusher promptly engages the axle, and carries the truck up without any effort at all on the part of the workman, who merely holds the handles to steady the truck. The conveyor is operated by an electric motor. It will of course work in either

(Continued on page 284)



Center: The old method of strictly hand-trucking. *Below:* Slinging the gang-plank to the hoist that does the heaviest part of the work. *Above:* An even more effective device, which carries the trucks up the incline on the conveyor chain while the man merely steers and steadies them.

The mechanical stevedore contrasted with the old way of loading sacked grain

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Unscientific Lawmaking

"AFTER one year from the ratification of this article, the manufacture, sale, or transportation of intoxicating liquors . . . for beverage purposes is hereby prohibited. The Congress and the several states shall have concurrent power to enforce this article by appropriate legislation."

So runs the Eighteenth Amendment; and the courts are busy trying to decide to the satisfaction of all parties what it means. We predict that this effort will be a thankless one, for the reason that it means—nothing. It strikes us as the most delightful example we have yet met of that legislative ineptitude which is so large a feature of our present-day government.

"Concurrent power." If this means anything, it means that the 49 national and state legislative bodies may all pass laws, which are to be applied simultaneously to the enforcement of prohibition. This leads to two possible results. Either state and federal laws are to be applied at the same time and in the same place, or they are not. Now under the second of these alternatives, if we pass over the suggestion that the state laws are not intended to be enforced at all, we shall find that the only way out is to enforce the state laws in the state that gives them birth—where alone they can be enforced—and let the federal laws lapse so far as they conflict. Then we are brought to 49 varieties of prohibition—one for each state, and one for the District of Columbia and the territories, where the federal enactments can be applied. In this way state and federal laws can be made concurrent; but the solution thus presented is hardly a satisfactory one.

On the other hand, our first alternative is even worse. If state and federal laws are to be enforced simultaneously in the same place, we shall have offenders and prospective offenders analyzing them to find which offers the best opportunity for acquittal and the lightest punishment on conviction. The seller of "booze" would then be found wildly dodging about in effort to keep out of the hands of the federal marshal long enough to give the county sheriff time to arrest him. The marshal and the sheriff would be competitors for the privilege of bringing the proceedings—the one with the desire and intent of getting a conviction, the other hoping to bring off an acquittal.

Then consider the question of "concurrent power" in connection with the definition of intoxicants. New Jersey has passed and will defend before the Supreme Court an act legalizing 3.5 per cent of alcohol; New York, we are told, will make it 6 per cent. The Court has already laid down the self-evident proposition that since the amendment does not define the intoxicating percentage, this must be done legislatively. The Court has said Congress may do this; will it, on the text of the amendment, say that the state legislatures may not?

Of course, the Supreme Court has already made for itself good precedent for interpreting the Congressional meaning when that is not clear. If this precedent is to be followed and perhaps a bit extended, we may soon have a decision which tells us what the learned justices conceive that the rights and duties of Congress and the states *should be*. Further than this the Court will not be able to go; nobody could undertake to read the amendment and say what Congress intended it to mean, so any effort at interpretation must reflect the attitude of mind of the interpreter.

We respectfully suggest to Congress that it either go out of business altogether, and leave the law-making responsibility where it now so often rests—on the shoulders of the Supreme Court; or else that it make a decent effort to frame its enactments so that they shall possess meaning. We could wish for a Supreme Court with courage enough to throw ambiguous enactments out of court entirely, and send them back to their makers to be done over and done right. As to the present case, we leave it to any business man to tell his Congressman why the phrase "concurrent power" is self-contradictory and meaningless.

Do We Need the Largest Navy in the World?

IN his recent testimony before the House Naval Committee, Rear Admiral Badger urged that our plans for naval construction should be so drawn as to give us by 1925 the largest navy in the world. This means that it will be necessary to increase our material in the way of ships, guns and general equipment fully fifty per cent. To make such a fleet effective it would be necessary furthermore to acquire some score or so of naval stations all over the world. Therefore the mere first cost of making this enormous material addition to our fleet would, after all, be but the beginning of the financial burdens imposed.

But do we require the largest navy in the world; and if so, when did it become necessary? Before the war, and even after it had been long under way, such patriotic advocates of a strong navy as the Navy League and the National Security League considered that it would be sufficient if our navy held an unchallenged position as the second naval power—and that was in the days when the German Navy was the pacemaker in naval construction and was well recognized as the only outstanding menace to the world's peace.

Today, with the German navy absolutely eliminated, the United States Navy has reached its goal. Not only is it in the second position, but so powerful has it become that, by the time the three-year program is completed, the United States will be as powerful as the next three great naval powers, Japan, France and Italy combined. In view of this highly satisfactory condition of affairs, the taxpayers of the United States are asking what is the unexpected and seriously menacing new conditions in international affairs which makes it necessary for an eminently pacific people, like ourselves, to go on adding to its fighting fleets on a far greater scale than the advocates of preparedness considered necessary, even in the days when the German menace loomed large on the international horizon.

Surely we are doing pretty well in the way of naval construction as it is. We are building no less than eighteen capital ships of greater size and power than any to be found among the fleets of other nations. By the time these ships have been completed, having in view the ever-increasing cost of labor and material, they will have made a draft upon our Treasury of at least $750,000,000. To the sums appropriated for this purpose the General Board of the Navy recommends that we add another big appropriation for building two dreadnoughts, one battle-cruiser, ten scout cruisers, four destroyers, six submarines, besides other smaller craft. This will mean an additional expense of about $250,000,000, or, a total of ships under construction and appropriated for of about one billion dollars.

Meanwhile the world's leading navies are those of our own allies in the late war, with all of whom we are at present, and expect to remain, on the most friendly terms. Consequently, the General Board of the Navy should be prepared to answer the question of the taxpayer when he demands why, in the presence of these favorable international conditions we are to be asked to add this enormous financial burden to those which the nation already carries.

The Lesson of the Flight to Australia

THE outstanding lesson taught by the Army long-distance flight across the American continent and back which was held last summer, was the crying need for suitable landing fields; and as the fuller details of the recent 12,000-mile flight from England to Australia are made known, the same lesson is taught with even greater emphasis. The first stage towards long-distance flight was reached when the airplane was developed to a point where it was thoroughly reliable for non-stop flights over great distances between selected points. That the airplane has reached that point of perfection has been proved many times during the past two years, notably in the non-stop flight of the Vickers-Vimy bombing machine from Newfoundland to Europe, and later during this remarkable 12,000-mile journey, in which the appointed resting places were reached without mishap. But when we come to the question of starting and stopping grounds, there is quite another story to tell, and it is evident that the question of aerial transportation depends upon the provision of carefully selected, well drained and thoroughly equipped landing grounds.

There have been many stories of this Australian flight, but in its emphasis upon the landing-field question as the outstanding problem in future world-wide flights, the most illuminating is an account written by Commander Dawson, of the Royal Navy, in *The Empire Mail*. The machine, fully equipped, had a weight of about five and one-half tons. The maximum speed of the Vickers plane is 104 miles per hour; but Captain Ross Smith throttled his engines down to a cruising speed of between eighty and ninety miles per hour. The unexpected feature of the trip was the run of unusual, wet and stormy weather which was encountered throughout a large part of the journey. In the very first stage from London to Lyons, France, the aviators encountered heavy snow storms and extreme cold, with 25 degrees of frost. The next landing was made at Pisa, where the aerodrome proved to be "very sticky as a result of the recent rains." Upon the start from that place, the machine sank in the soft ground, and after three unsuccessful attempts the machine was able to get away only when one of the crew sat on the tail of the airplane to prevent it from pitching forward. After sufficient speed had been obtained, the live weight on the tail was hauled into the cockpit, just before the machine left the ground. After a landing at Taranto they flew through exceedingly bad weather to Suda Bay in Crete; whence they got away from a "very boggy aerodrome," and steered south for 250 miles to the African coast, experiencing "strong winds and bad visibility."

On the next stage to Damascus, they were "persistently hampered by bad weather and heavy rain." Upon reaching Ramadie, so violent was the weather that a large number of Indian lancers were enlisted to hold on to the airplane. On November 24th they reached Karachi, having made the run from London to India in only twelve days. The course then lay by way of Delhi, Calcutta and Rangoon to Bangkok. Between Bangkok and Singora, "the weather was appalling," says Captain Ross Smith, "and at times we were nearly blinded by the rain." Here a heavy storm arose which made it necessary for the crew to hold on to their machine until daybreak, when they found that the aerodrome was half under water. Two hundred men worked to make a clear track for the get-away which was made through large pools of water which flung spray over the whole machine.

Then came the last and most difficult stages of the journey across the Dutch East Indian Islands. At Sourabaya, the airplane "sank up to the axles," but was ultimately extricated by means of 200 men and the use of long planks. In the endeavor to make a possible runway for starting, a local engineer collected all the bamboo mats he could find, pulling down some native houses to obtain the number required. When the start was made, the mats flew up and caught in the tail of the machine, which again became bogged. Finally, they got away on a road of laced mats 350 yards long and 20 yards wide. Port Darwin was reached on December the 10th.

The landing experiences of the Australian flight seem to be now repeated in the attempted flight throughout the length of the African continent. If long-distance aviation is to become a commercial success, a large share of future appropriations, whether governmental or private, should be devoted to the provision, not of extemporized, but of thoroughly well built and completely equipped aerodromes, with all facilities for obtaining fuel supplies, stores and other indispensable necessities.

Electricity

Tests on New Insulating Material.—The Schnetzer insulating material for electric conductors has proved most resistant to atmospheric influences and to chemical fumes, according to a German periodical. In a stearine factory where rubber insulation was usually destroyed in four to five months it has been in use two to three years and is still in good condition. It has been used in wet locations, with good results, and resists acid better than lead coating. The material is coated with a special varnish, the detail composition of which has been most carefully withheld from general circulation and is still kept secret.

A New Type Coated Electrode has recently been brought out, for which interesting claims are made. It is said that the coated electrode in this instance is not a completely inert covered electrode holding the arc within a sleeve and covering the deposited metal with slag, but an electrode which has chemicals in its coating to attack the oxygen and nitrogen of the air with a greater chemical affinity than steel at the welding temperature, so that the steel is saved from the weakening influences of these two elements both by the action of the chemicals and the enveloping of the arc in the outwardly-moving gases of the oxygen and nitrogen combined.

Variations of Long Electromagnetic Waves.—The observed direction of radio waves as obtained with a direction finder varies with time. When long waves are used, such as those from very high power stations, the variations of direction are of the order of 90 degrees. No such large variations are found for short damped waves produced by spark apparatus. Lieut.-Com. A. Hoyt Taylor of the United States Naval Aircraft Laboratory, Bureau of Standards, has worked out a method of increasing the sharpness of determination of direction and a theoretical explanation of the variations of direction based on the existence of media in the earth's atmosphere, capable of reflecting and refracting the waves.

The Why of Incandescent Lamps.—An incandescent lamp is essentially a filament of some material suitable to withstand high temperature and yet not vaporizing rapidly. By virtue of the filament being heated to incandescence by an electric current it gives light. To prevent burning up it is operated either in a vacuum or in an atmosphere of inert gas, or some gas which does not contain oxygen or any other element that will enter into chemical union with the filament. In a vacuum it suffers by reason of the absence of a pressure to hold it together and to resist a tendency for it to fly apart or vaporize. This difficulty can be overcome by the use of a gas in the bulb, thus making it possible to operate at high temperature without much vaporization, but there are heat losses through the path provided by this gas. In the case of small lamps the wattage thus lost would make gas-filled lamps actually less efficient than vacuum lamps, but as far as larger sized lamps are concerned carefully checked up developments show that there is a considerable gain in efficiency.

Dust Elimination.—The latest improvements in the matter of eliminating dust from gases by means of electricity provide for the filtration of said gases in a powerful electric field. Very high tension electricity is needed, so the alternating current generated at 110 volts and 25 cycles is transformed up to 50,000 volts. This high tension current is then rectified by vacuum tubes, which are a sort of unilateral electrical conductors. The actual dust filters are composed of metal plates of ordinary commercial sizes, inside which thread-shaped electrodes are maintained at high tension. The tubes may be placed either vertically or horizontally, and the arrangements differ according to the precise purpose in view. The particles of talc, cement, stone dust and metallic oxides can all be deposited. The dust of pyrites is deposited at a temperature of about 400 degrees C., and also the vesicles of the sulphuric acid to form the concentrated liquid. The vacuum tubes used in this work, continues the description of this French system contained in *La Technique Moderne*, are static apparatus which resemble X-ray tubes in appearance, and they effect the same result as the rotary rectifiers which are generally employed.

Science

Anthropological Explorations in Florida.—The Smithsonian Institution has recently published a preliminary note on the results of an anthropological survey of the southwestern coast of Florida made by Dr. A. Hrdlicka in November, 1918. The region of the coast south of Key Marco, which was supposed to be of no great account as far as aboriginal remains were concerned, was found to be full of sites, shell heaps, platforms and mounds, with canals and other evidences of former Indian occupation, the remains covering in individual instances 20, 30 and even 80 acres of ground. All of this interesting material is still intact, so far as scientific exploration is concerned.

The French Optical Institute.—An important step toward building up a great optical industry in France has been taken by the French Ministries of Public Instruction and Commerce, under whose auspices there has just been created in Paris an establishment known as l'Institut d' Optique Théorique et Appliquée, with General Bourgeois as its president. The institute will include a school of advanced optics, a research and testing laboratory, and a professional school. Although measures have been taken to secure a government subvention, an appeal for funds has also been addressed to scientific and industrial organizations. During the decade preceding the late war, France imported from Germany optical instruments to a value of 23,000,000 francs. Although the science of optics was so largely the fruit of French genius, as embodied in such men as Foucault, Fizeau and Fresnal, Germany had acquired something like a monopoly of applied optics, and had developed means of instruction in this art, notably at the University of Jena, far surpassing those to be found elsewhere in the world. It is this preeminence which France now purposes to dispute.

Methods of Measuring Visibility are discussed by Mr. A. H. Thiessen in the current number of the *Monthly Weather Review*. This is a subject that has come into prominence lately, owing to the requirements of aeronauts and artillerists. During the war the meteorological corps of the U. S. Army observed visibility on a scale of six degrees, ranging from "very poor" to "excellent," according to the maximum distance at which objects could be seen. A somewhat more detailed visibility scale has recently been adopted in Great Britain. Instead of selecting objects at random, without regard to size, color, kind of background, etc., for the purpose of estimating visibility, Mr. Thiessen suggests that observations be made on a target placed at 200 meters from the point of observation. This target is to be viewed through smoked glasses having eight degrees of transparency. The smoked glasses take the place of sections of dusty or misty atmosphere, and may be so selected that measurements made on the standard object 200 meters away will be comparable to measurements made with the naked eye on objects placed at various distances from the observing point.

An American Compend of Chemical and Physical Constants.—It is a trite remark that the Germans have hitherto largely monopolized the business of making compendia of scientific data, and that during the war the scientific services engaged in war work for the Entente and American governments found themselves in the anomalous situation of being obliged to depend upon these (fortunately excellent) publications of the enemy. This was notably true in regard to collections of chemical and physical constants. German works, especially the famous Landolt-Börnstein-Roth tables, were an indispensable part of the equipment of every important laboratory. A first step toward altering this situation is announced by the National Research Council. In coöperation with the American Chemical Society and the American Physical Society, and with the aid of private funds, the Council proposes to prepare and publish a critical American compendium of chemical and physical constants. It is estimated that the undertaking will cost at least $100,000. One noteworthy feature of this project is that the promoters plan to collect information from business and industrial concerns whose work is based on applied chemistry and physics as to the data which the proposed work should include in order to be most widely useful.

Aeronautics

Helium Gas Activities.—A joint Army-Navy Board has been created by the Secretary of War and the Secretary of the Navy for the purpose of coördinating the various helium gas activities. Because of the fact that so many of the problems in connection with helium gas concerns the Department of the Interior, the Bureau of Mines of that Department has been invited to have a representative meet with that board.

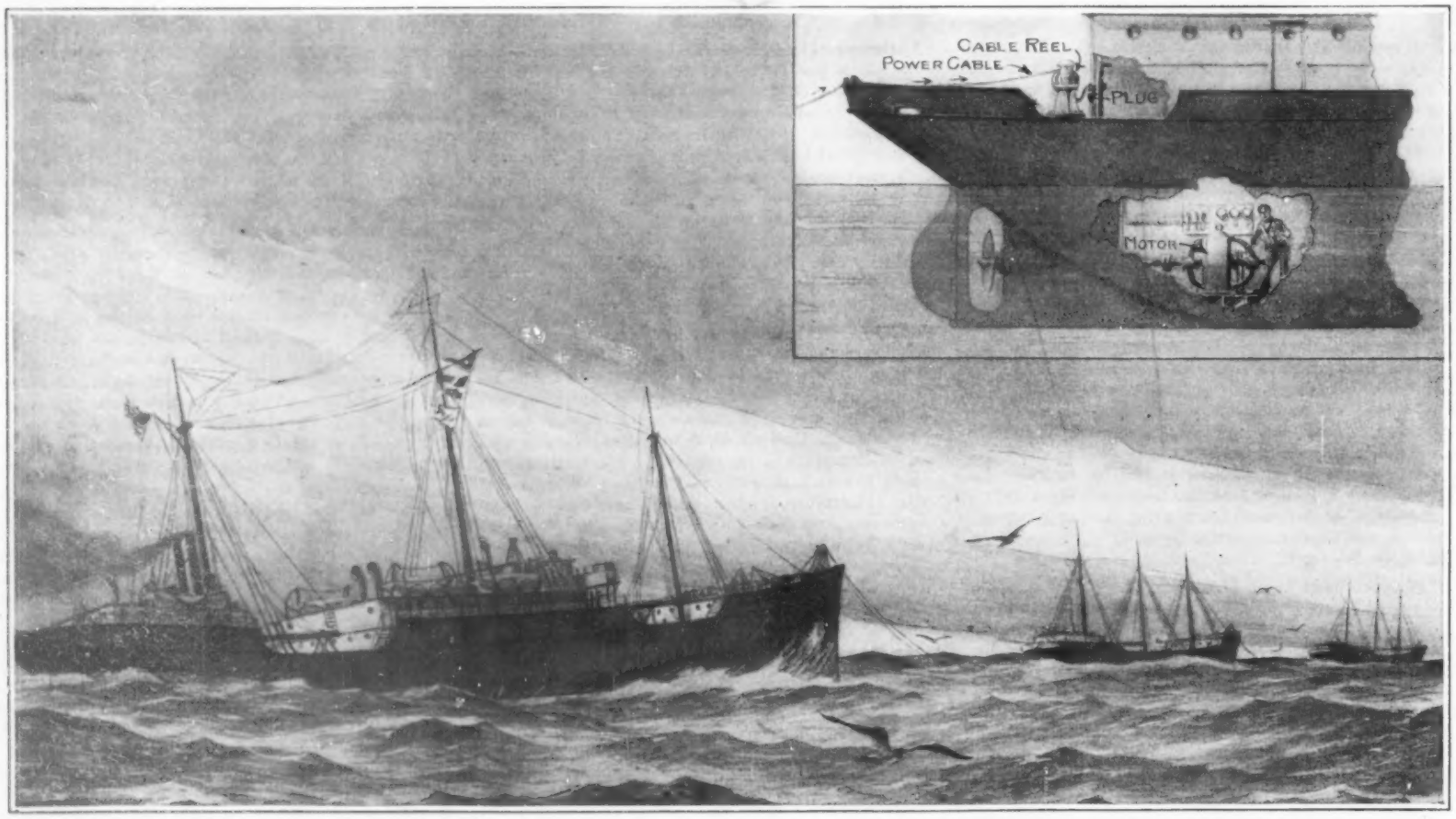
Inexpensive Airplane Motor.—It is interesting to note that the demand for inexpensive airplanes is bringing about the wide use of the Ford automobile engine for aerial purposes. This type of motor has been used to good advantage on a number of single-engined and multiple-engined airplanes, and, despite its somewhat great weight for its horse-power, it proves very satisfactory because of its reliability. And as a result of all this at least one manufacturer has gone into the business of making modified Ford engines particularly suited to airplane service. One of these develops 35-40 h.p. at 1800 revolutions per minute.

Portable Engine Cranker. —A portable engine cranker designed and built under the supervision of the Equipment Section, Engineering Division, McCook Field, was successfully demonstrated some little while ago. The design allows for the cranking of engines mounted in various airplanes, ranging from the Curtiss training 'plane to the Martin bomber types, on rough and uneven ground. The outstanding feature of this cranker is that it will accommodate all right-hand engines fitted with a standard hub, not mounting a spinner. It develops a starting torque 50 per cent greater than that necessary to turn over a cold Liberty twelve-cylinder engine.

A Proposed Trans-Atlantic Flight.—Again it is reported that a French machine will shortly attempt an Atlantic flight. The route chosen is that old French favorite—from Dakar to Pernambuco, and an attempt will probably be made in April or May. Although the distance between the two towns is some 1,900 miles, the machine will be able to cover over 3,000 miles without a stop. It will be fitted with three engines, which, instead of being isolated and each actuating an individual propeller, will be grouped in a common engine room. They will be able to work together, and in the event of one or more of the engines failing, the inoperative machinery can be isolated and repaired while the remaining engines sustain the airplane in the air.

How Many Passengers?—Speaking of the Curtiss "Eagle" machine, which has attracted quite a bit of attention since its introduction some few months ago, an aeronautical engineer has the following to say: "Abroad the practice has been to use a single-motored airplane of 400 horse-power to carry loads of from four to six passengers, and the larger types for larger parties. But such single-motored machines do not offer the margin of safety so highly desirable, unless landing fields exist every ten miles. Why not meet the difficulty, as the Curtiss engineers think they have done, with the 150-horse-power, three-motored type? Two or three machines can be available. Loads of any size can be carried without fuel waste, and with entire safety since any two of the 150-horse-power engines will maintain the Eagle in flight. In fact, with one motor only in operation, the Eagle has a circle of 40 miles in diameter in any part of which it can land."

Aerial Photography is so much in everyday demand that the Curtiss organization has seen fit to inaugurate an aerial photography department. Captain Morrell, recently of the Royal Air Forces, in charge of the new department, has the following to say: "Every air picture shows most of what four views taken from the ground can show, plus the view from above, which the camera cannot usually get from the ground at all. I believe that important factories and other large businesses, as well as all important municipalities, will soon be considering air maps and air views as a necessary means of presenting themselves and their advantages to the public. Aerial photographs of harbors, congested city districts, etc., for scientific purposes will be made. Real estate offices will wish to show the nature of their properties by an agency which is as accurate as a map and far more vivid. Timber properties, Forest Patrol Service, U. S. Geodetic Survey, etc., will utilize the aerial camera."



The power ship preceded by two of the electrically-driven towboats, and (in the insert) the details of the power cable and driving motor

Navigating Ships in Trains

An Electrically-Driven Power Boat That Supplies Current to the Motor-Equipped Units of Its Convoy

By Robert G. Skerrett

THE engineering world generally stood aghast a brief span back when electrically-propelled ships were proposed. The conservative members of the fraternity could see nothing to be gained by supplanting the time-honored steam drive. This seemed to them to be going far afield in search of troublesome complications. They prophesied all sorts of breakdowns, not to mention costly failures. Happily for us, their pessimism did not prevail.

We know now with certainty that the electrically-driven vessel possesses real advantages over her steam-propelled sistercraft, and, by reason of this, that the new type has come to stay and to grow in numbers. Further, we shall see presently that the scope for electricity afloat is a much wider one than the foregoing innovations indicate. The collier "Jupiter" and the battleship "New Mexico" have revealed economical virtues of prime moment, and they have demonstrated that they can be controlled from the bridge in a fashion akin to a trolley car. But, despite their recognized betterments, these craft are but examples of up-to-date self-sufficient units designed to meet only their individual propulsive needs. Their power is for their own consumption alone; they have no interest in helping other ships with whatever excess energy they may have available.

If one will look over a list of American shipping it will soon become apparent that we have an immense tonnage of craft depending upon the motive power developed by other vessels. That is to say, they must turn to tugboats and steamers of various sorts to shift them from point to point. A little further analysis will bring out the fact that this method of transportation is more or less archaic and inefficient largely because the tug cannot utilize to full advantage the propulsive effort of its engine installation. Its one means of translating horse-power into advance is the screw at the end of the propeller shaft; and that agency will churn the water somewhat ineffectually unless the motion forward is fast enough to avoid hampering eddies or, worse still, cavitation. As they operate today, our towboats, taking them generally, are exceedingly wasteful consumers of fuel—in short, they are muscle-bound and appear to be utterly incapable of using helpfully the pulsing pressures in their boilers.

It was this condition of affairs that arrested the attention of Mr. William T. Donnelly, a mechanical engineer of New York City, quite fourteen years ago; and with determination he set about evolving a typically modern solution of a neglected department of water transportation. Research and reason convinced this technicist that it would be quite feasible to turn the tugboat into a central station purposely designed to generate more energy than that required for her own driving throughout a range of serviceable speeds, and then, in the form of electricity, to distribute the surplus current, by waterproof cables, to other boats fitted with electric motors for the functioning of their screws. That is to say, to give to each unit of the otherwise impotent convoy the means of self-propulsion so that they would no longer move as so many dead loads attached to a succession of towlines, but be able to maneuver with a degree of independence and to utilize their borrowed "juice" with a maximum of good effect. The project was revolutionary; but in principle it violated no technical precedent, for the object was merely to apply afloat what had been done on shore by railroads, factories and communities.

The electrical towboat in actual use on the Hudson River

As the more indulgent of his critics saw it, the design of the towing and towed vessels presented no great problems; the crucial feature would be the transmission cable. They asked: Could this be made both watertight and flexible enough to satisfy the somewhat rugged service to which it would necessarily be exposed? On this count they put it squarely up to Mr. Donnelly to make good in fact; and this story, in part, has to do with the manner in which he has done that very thing.

Rationally, Mr. Donnelly elected to begin in a comparatively modest way, and in 1909 the lines for his experimental craft, the "Dawn," were drawn. The boat was built and launched in 1914, and has an overall length of 50 feet, a beam of 12 feet, and draws approximately 4 feet of water when full laden. The yacht's power plant insured a surplus of energy ranging from 20 to 30 horse-power; and this was intended to be fed by cable to a second boat, then not in being. Without going into details, let it be said that the "Dawn" met in every particular the expectations of her owner and gave him, besides, a wealth of valuable data.

In the winter of 1918, a sisterboat of like model and identical dimensions was taken in hand, and was completed by the end of October, just gone. The "New Era," for such is the second yacht's name, has no power plant, but she carries a 20-horse-power electrical motor for the operating of her single screw; and the

(Continued on page 284)

The X-Ray in the Shop

By George Gaulois

THE difficulty of detecting flaws and the presence of foreign bodies, of a metallic or other nature, in built up mica which is used for insulating purposes, has caused a leading electrical manufacturer to install an X-ray testing outfit for this purpose. As will be shown, the detection of such flaws before the mica is actually used for insulation purposes is highly important, as much damage and loss of time and money due to faulty mica, are averted.

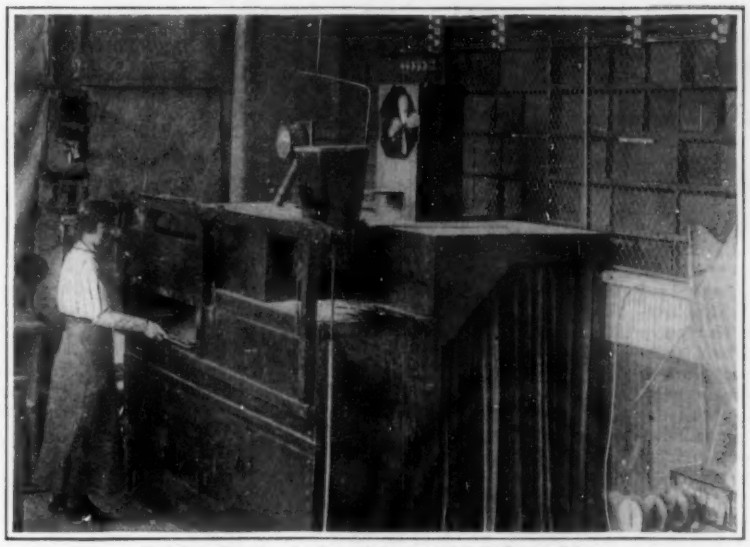
Mica, a substance which has a very high dielectric strength, is extensively used in the electrical industry as an insulator, especially in building commutators for direct current generators and motors. In this construction the copper segments of the commutators are separated by sheets of mica, to prevent short circuits between the copper segments. Mica is best for this purpose because of its high insulating properties, even when it is in the form of a comparatively thin sheet, and also on account of its very considerable heat resistance and mechanical strength.

When mica is received at the factory it is in the form of flakes varying in size, but none very large, and with a thickness of one one-thousandth of an inch. These flakes are given various treatments, and then built up into sheets which are cut to any desired size. These sheets are pressed in a hydraulic press.

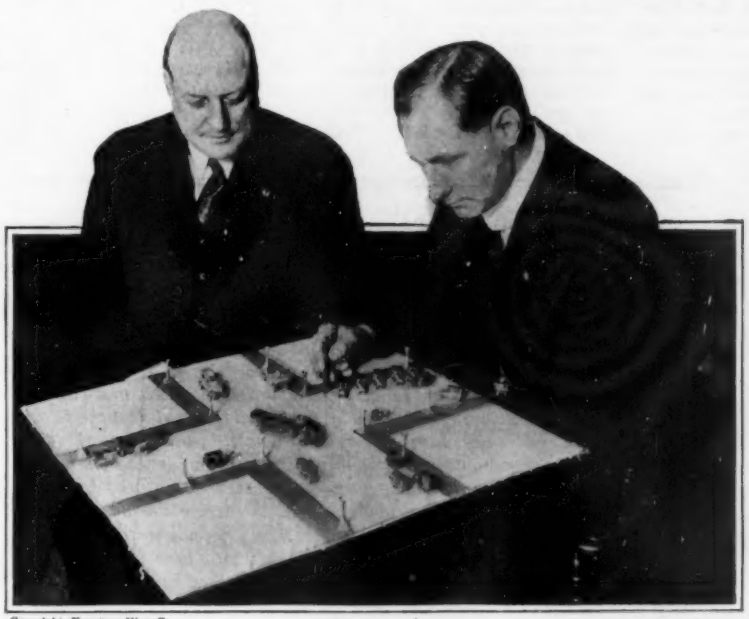
Since at best the bars are not very thick—about 1/32 inch—it is important that they have a uniform cross section, and be free from all foreign substances, because a thin spot in the bar or the presence of some small metal object would weaken its resistance, and probably cause considerable damage to the machine in the commutator of which it was used. A good many of the processes involved in building up these sheets are handled by girls, and it has been found that, in spite of all precautions, pins, bits of chewing-gum, tinfoil, wrappers, small pieces of wire, and other foreign substances are sometimes built up in the mica.

Since objects like these, as well as unevenness in the density of the structure, are invisible from the outside of the sheet, the X-ray method of testing is about the only one that will reveal these faults with any degree of certainty. The installation itself has features that are well worth description.

The testing is done in a light-proof cabinet, which is equipped with protection in the form of lead sheeting, so that neither the observer nor anyone outside can be burned by the rays. The section where the observer sits is merely a cabinet, painted black throughout and having a light-proof curtain over the door. Directly in front of the observer's face is a lead glass window through which she can see the reflection of the mica under test without danger of X-ray burns.



Testing sheets of mica with a special X-Ray cabinet



Copyright, Keystone View Co.

Miniature street crossing and vehicles used by Washington police authorities

On the front of the observing cabinet is another smaller cabinet which is divided laterally into two sections. The upper of these sections contains the

(Continued on page 286)

The Cleaning of Railroad Ballast

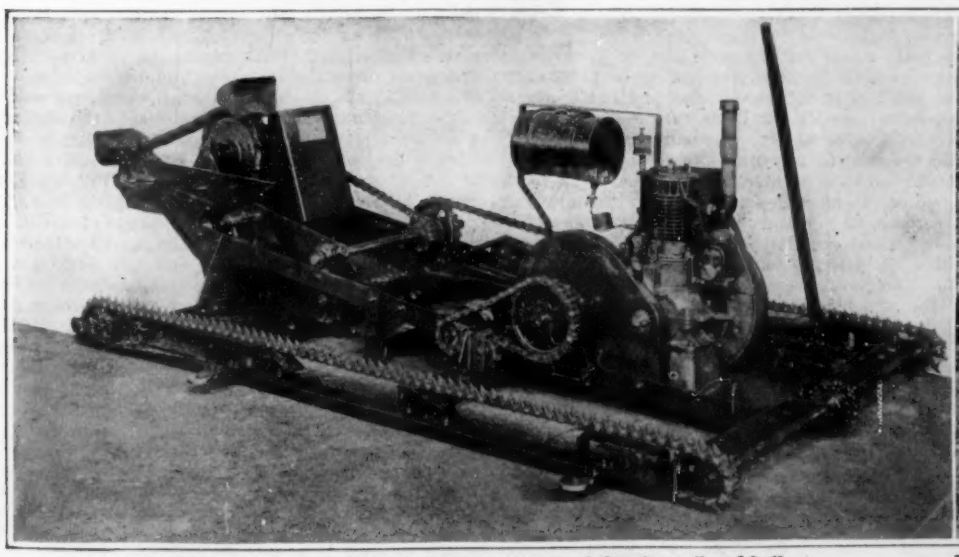
By Henry J. Edsall

IF wooden railroad ties are to be kept from rotting rapidly, proper drainage must be provided underneath, or at least at the ends of the ties, so that all surface water can drain away quite quickly. On account of the cinders and dust along the railway tracks, the stone ballast soon becomes clogged up with dirt, which interferes with the drainage. To overcome this, it is necessary to work over the ballast and clean out the dirt. Up to the present time this work has been done by forking the ballast over with forks, and taking out the dirt. This, however, is a slow and laborious operation, and for some time past railroad engineers have been on the lookout for some mechanical means of doing this work.

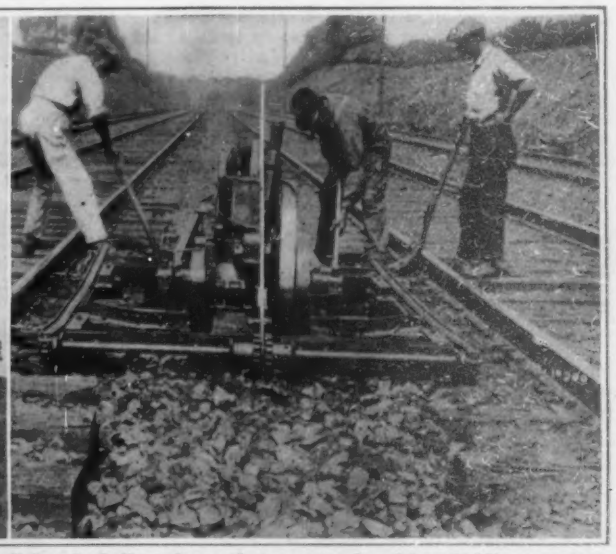
The machine shown in the illustrations is a dwarf chain-and-bucket elevator driven by a small gasoline engine, and a short section of wire screen with a steel dirt pan underneath. All parts are as compact as possible, and the machine is built very low down so as to clear passing trains. It is supported on chains at each side which pass around sprocket wheels at each end, these chains being moved by a ratchet lever in the center of one end shaft. The chains rest on the ends of the ties and there are two guide wheels, on each side, which bear against the webs of the rails and keep the machine properly centered between the two tracks. The elevator buckets dig up the ballast and deliver it to the screen, the clean ballast sliding off the end of the screen, back to the roadbed, and the dirt going through to the dirt pan underneath, from which it is shoveled by hand. The men help the machine by pushing the ballast from the ends of the ties over towards the center so that the machine can pick it up. This method of cleaning ballast expedites the work very materially, it being found possible to clean a rail length of about 33 feet in 45 minutes with a crew of 5 men.

Street Accidents in Miniature

THE Washington (D. C.) police authorities have introduced a novel way of trying street accident cases. In the traffic court, miniature models of all sorts of vehicles which use the city streets are at hand, in order to help the officers and witnesses in demonstrating just how an accident took place. The model vehicles and a miniature street crossing are shown in the accompanying illustration, together with two of Washington's traffic experts engaged in solving a typical case. It is indeed a sign of the times that more and more models are being employed by the courts as aids in welding links in the chains of evidence.



This little machine expedites the important work of cleaning railroad ballast



Using the ballast cleaner between tracks without holding up traffic

Succeeding in Chemistry

A Relatively New Field Abounding in Opportunities

By Raymond Francis Yates

THE science of mechanics is as old as civilization itself. Not so with chemistry as it is understood today. The foundation of chemistry as a distinct science was laid but a century ago. Like all other sciences, as it grew it branched out. When the knowledge of the human race increases along any specific line a point is reached where it becomes logical to divide the field up into various branches. This happened in the science of chemistry about thirty-five years ago, and today we have organic chemists, inorganic chemists, analytical chemists, chemical engineers and electrochemical engineers. Many chemists or chemical engineers specialize in different fields such as the manufacture of paints, dyestuffs, steel, paper, coal tar products, explosives, etc. It is said that one quarter of the industries of this country are guided by chemists.

When the writer started to gather his data for presentation in this article he sought the professional advice of a man of known standing in the chemical field. His choice was Dr. J. C. Olsen, Professor of Chemistry at the Polytechnic Institute of Brooklyn and Secretary of the American Institute of Chemical Engineers. Dr. Olsen is well qualified to give counsel to young men about to take up chemistry as a profession. He is acquainted with the chemical industries of the country and as professor in chemistry he has assisted and guided many young men on their way to success. Dr. Olsen's good advice has been infused into the following paragraphs in an indirect way as the author did not deem it advisable to quote.

All of our colleges give courses in at least three branches of chemistry. A man may train himself to be a chemical engineer, research chemist or analytical chemist. The three fields are arranged in the order of their importance and compensation.

The analytical chemist is an important part of every plant or factory that uses chemistry in its process. The work of the analytical chemist is routine in every respect and there is little or no opportunity to carry on work of an original nature. The analytical chemist is really a watchman to see that things go right. He must see that a perfectly uniform product is turned out and that no disorders occur in the system. For instance, in the steel foundry it is his task to take a sample from each heat and analyze it to see that it contains a specific amount of each ingredient.

Nearly every industry has its "works" chemical laboratory aside from its research laboratory. The "works laboratory" contains from one to fifty analytical chemists. The salary of these men ranges from $1,200 to $6,000 for the chemist in charge. The average salary of the analytical chemist is in the neighborhood of $2,200.

It is not essential that an analytical chemist be a college graduate. In fact, it can be said that the majority are not college graduates with a full four-year course. The head of the laboratory is invariably a college graduate. Many young men start as an assistant to a chemist in an analytical laboratory and by practice gradually develop into a chemist with sufficient knowledge to handle the particular kind of analytical work common to the laboratory in which they are employed.

The research chemist is a man in a position to do a tremendous amount of good. He has an earning power, which, in most cases, is limited only by his personal capacity. He must possess initiative, originality and perseverance. Not even the slightest detail must escape his notice during research work. He must be of the strict scientist type, in possession of a great mass of theoretical knowledge.

It is the work of the research chemist to perfect chemical processes by increasing efficiency and the quality of the product. He must also develop entirely new processes. Oftentimes, years are spent in the development of a new process involving not only the time of the research chemist but of a staff of chemists working under his direction. The responsibility of the research chemist is very large. He generally spends great sums of money in carrying on his work, and, although as a scientific man he cannot guarantee results, he must use every precaution to see that his work is not productive only of expense and disappointment.

The research chemist must be a college graduate with at least two years of University training. His salary will range from $6,000 to $20,000 per year. In exceptional cases the salary has been known to go beyond this figure.

Chemical engineering is the highest branch of chemistry. A chemical engineer is a thoroughly trained man in general engineering science, and, aside from this, he must possess all of the qualifications of the research chemist. To be really successful, he must be a man with great vision, force and resourcefulness. The chemical engineer is a creator of industry. A few years ago scientists were in possession of a great mass of chemical knowledge relative to many important processes, but owing to a lack of engineering talent along these particular lines, it was impossible to apply this knowledge to industry. The chemistry of the Solvay soda process was well known a number of years before it was put in practice in a commercial way. It was the chemical engineer who did this. The same is true of the contact process of producing sulphuric acid; it simply had to wait until our educational institutions produced men who were capable of coping with the practical industrial problems involved.

Thirty-five years ago, chemical engineers were not known. Today the future of our country rests largely with their genius, initiative and originality. Our industries today are depending more and more upon chemical products. Not long ago, steel was a matter of pig iron and carbon. Not so today. Our manufacture of steel rests entirely upon the electro-thermic production of such metals and alloys as ferro-chromium, ferro-silicon, ferro-manganese, titanium, silicon, etc.

Chemical engineering is, without the slightest doubt, the greatest and most promising field today. It offers the largest rewards to its honest followers. It is a field for great minds and big men.

It has been said that business to science is like oil to water, but this is not true of chemical engineering. The successful chemical engineer must be a business man of considerable ability. He must be capable of surveying the field he is working in from the business standpoint. He must be able to figure costs. In fact, this is one of the most important phases of his work. If, for instance, he is asked to develop a new plant for the production of caustic soda, he is brought face to face with a business problem as well as an engineering problem. The men of capital who requested him to develop the new plant are unable to apply their business ability to the problem because they cannot understand the engineering features.

The salary of chemical engineers ranges from $10,000 to $30,000 per year. There is really no definite limit. Oftentimes men who perfect great processes and develop new industries receive for their labors a substantial amount of stock in the company. Many become general managers, superintendents, works managers and chief engineers. A large percentage enter into business for themselves.

The education and training of a chemical engineer must be very thorough. Four years of college and three years of university work are really necessary in the average case. Unlike the electrical or mechanical engineer, the chemical engineer must not only be trained in chemistry but in electricity and mechanics as well. No engineering profession demands greater study, concentration and hard work. On the other hand, no other type of engineer has before him a broader, grander and more promising field.

Dr. Olsen reiterated during the writer's conversation with him, that no other scientific field required more honorable character than that of chemistry. Analytical chemists, research chemists and chemical engineers are all men who are trusted with knowledge, which, if disclosed, would many times ruin their employers. One of the very first statements in the code of ethics adopted by the American Institute of Chemical Engineers is that the members "shall be guided by the highest principles of honor."

A branch of the chemical field heretofore not mentioned is that of teaching. In this field there is the instructor, the assistant professor, and the professor. Men engaged in this particular branch of chemistry have to be philanthropic. They can never hope to realize a salary that is commensurate with their learning and ability. They must of necessity be unselfish men, not actuated with mercenary motives. Nevertheless, they are men who always seem to live comfortably and enjoy life. Their economic importance cannot be over-estimated. Most all of our new knowledge in theoretical chemistry is brought forth by professors through experiments conducted in their spare moments. Professors also have considerable time at their disposal and some develop a consulting practice which adds considerably to their income. Many new processes have been perfected by professors working in their spare time.

The writer asked Dr. Olsen if a man without college education had a chance in the chemical field. He was told that few men won out without the proper professional training especially in the branch of chemical engineering. However, there are always exceptional cases. Dr. Olsen said that close observation had shown him that the earning power of the college trained man generally increases over that of the self-trained man with sufficient speed to pay amply for the training.

EVERY young fellow on the threshold of manhood must decide what his life's work is to be. Many decide before they enter college, some after, and others set out on life's journey aimlessly. The young man who decides upon a technical career generally finds it difficult to choose the one he is best fitted for. Today is the day of the specialist. The fields of engineering and scientific endeavor are so multitudinous and diversified that every young man contemplating a technical training should make sure that this, his most momentous decision in life, will bring him into a field that he will love; into a work that will ever receive his devotion and interest. To this man success will be but the natural outcome of faithful service. This series of articles has been prepared to help young men choose their life work; to help them survey the various technical fields and to receive the advice and counsel of the successful men in each field. As a final word of introduction, the author wishes to say that it matters little how much a man knows; it is the manner in which he uses what he does know. This is a day of deeds.—THE EDITOR.

Lumber Industry to Help Cut H. C. L.

HOW the lumber industry can help the Government cut the high cost of living is the basis of a series of special investigations to be made by the New York State College of Forestry at Syracuse, and the most important investigation is to be made in coöperation with the U. S. Forest Service.

The high cost of women's heels is the basis of one report already made by the College of Forestry, in which the shoe industry is told how to make an enormous slash in the cost of the maple wood heel for women's shoes by closer utilization of the smaller maple lumber, instead of buying as at present large dimension timber, of the highest quality of heart wood, at a cost 33 per cent higher than the proposed method.

The most important step, however, is the closing of a contract between the College of Forestry and the United States Forest Service for a detailed survey of the wood-using industries of New York State, the report to be the basis of a public bulletin to be hurried to the consumer, to show the needs of the lumber using industries of the State. The survey will provide information on the industries, and will make possible the taking of future steps to better serve the markets.

At present, such quantities of forest products are used in the State that the supply of raw material is dwindling, and radical steps must be taken to prevent waste, and also to provide as far as possible the material used from the forests of this State, and avoid the sending as at present of $80,000,000 or more a year to outside States for raw material. Unless the wood using industries are thus assisted, many will be forced to leave the State to get closer to the raw material.

The joint State and Federal survey will be started probably the first of September, and rushed to a conclusion by experts from both the College and the Forest Service.

Seeking the Seven-Mile Ceiling

Details of Major Schroeder's New Altitude Record of 36,020 Feet

By Ralph Howard

IN the week of August 22nd, 1909, there was held at Rheims the first international airplane meet. Those of our readers who still have in their possession our issues of September 4th and 11th in that year will doubtless read with amusement the account then given of what were to that date record-breaking performances of outstanding character. Farman and Bleriot and Curtiss and Latham flew at speeds in the neighborhood of 45 miles per hour; they stayed in the air for three and four hours; they covered 100 and 200 miles in single flights. But the particular item which is of major interest right here is the winning by Latham of the prize for altitude with a mark of 155 meters (508 feet). Perhaps some idea of what this meant at the time may be gleaned from considering one of the speed events in which two of the contestants "flew within twelve feet of the ground," to quote our correspondent at Rheims, while the third risked life and limb by venturing to the extreme height of 150 feet. Later in the week Latham himself covered part of an endurance flight at the "prodigious height" of 300 feet!

These early efforts to boost the ceiling of the airplane were fraught with altogether as much of the pioneering spirit as the present-day assaults upon the altitude record; but in compairson with late performances, they look feeble enough, to be sure. In spite of the fact that we have pushed the airplane to heights more conveniently measured in miles than in feet, we continue to eclipse existing records by margins greater than the entire distance between Latham and the ground when first he won an altitude prize. Thus, last year Rohlfs set the mark at 34,610 feet; and last week—at least it was last week as we wrote these lines—Major Schroeder has gone him 1410 feet better in taking his machine 36,020 feet off the ground.

The question "Where will this thing stop?" which first occurs is really of less interest than the questions "How do they do it?" and "What is the weather like up there?" They do it, in fact, with surprising ease, if we rule out for the moment the question of physical discomfort. Major Schroeder rode in a La Pere machine, with a 400-horse-power Liberty motor. The development of this full amount of power at all altitudes independently of the reduced supply of oxygen from the extremely rarified air, is made possible by the supercharger. This, as our readers will recall, is a gas turbine plus a centrifugal air-compressor. The turbine gets its power from the exhaust, and at 22,000 revolutions per minute it is easily able to operate the compressor so as to insure for the engine a supply of air at the full 14.7-pounds pressure of sea-level. After that high flying becomes merely a matter of personal courage and endurance.

Major Schroeder on his record-breaking flight was dressed more heavily than any Arctic explorer. Between the fur and the outer lining of his costume were flexible electric heating-units, connected by silk-covered wires with the power plant of the plane. Gloves, headgear and moccasins were similarly equipped; while the aviator wore an oxygen mask which guaranteed that he as well as the engine get the necessary amount of oxygen—a human supercharger, save for the fact that it employed stored oxygen from tanks instead of concentrating the atmosphere to the desired point.

Perhaps a word about the conditions seven miles above the earth's surface will not be out of place. Major Schroeder could tell us something of these, if that were necessary; but fortunately we possess more convenient means of finding out. Seven miles is an altitude very easily reached by kites and balloons, which can with equal ease carry automatic registering instruments of one sort or another. In this way we know that at an altitude of seven miles the temperature runs pretty uniformly around the 60-below-zero mark on the Fahrenheit scale. We know that, over the United States, the wind at this height blows steadily from the west at a speed somewhat in excess of a mile a minute. With these figures before us, we may be prepared to believe that the setting of altitude records is a pretty frigid business.

Although Schroeder says he is going up again, his experience was quite sufficient to bear out this remark. For one thing, when he landed he was temporarily, though none the less completely, blind. For vision depends, among other things, upon the liquid state of the "humors" inside the eye-ball. At the surface of the earth, so far as we are aware, these latter never freeze; but they obviously have a freezing point, and it appears that Major Schroeder found it; for he landed with his eyes completely frozen.

This was not the only bizarre incident of the flight. When he became blind from the cold and unconscious from exhaustion of his oxygen tanks, Major Schroeder of course lost control of his machine, which plunged toward the earth. Before the falling plane itself became visible, observers on the ground saw what looked like the tail of a comet suspended in the air beneath the clouds. The exhaust vapor froze in the air, and hung behind the plane in a long stream giving this effect, and leading to much wild speculation. Finally the falling plane was made out, and its occupant given up for lost; but at a height of barely 2,000 feet, while he was completely unconscious, his flying reflexes got to work and he righted the plane and glided to a landing.

The change from an atmospheric pressure of three pounds per square inch at seven miles to nearly 15 pounds at the ground was so sudden and so severe that the gasoline tanks on the machine were crushed in, and the aviator may count himself lucky that he did not suffer serious or even fatal injury from bends. But just to show that no little things like these can scare him, Major Schroeder says that as soon as he is able to fly again he is going after a record of 40,000 feet—with a bigger supply of oxygen, to the failure of which he attributes all his misfortunes on the voyage of February 27th.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Mass and Weight

To the Editor of the SCIENTIFIC AMERICAN:

In the SCIENTIFIC AMERICAN of the 17th is an article entitled "Weighing the Earth."

Surely in this article the word "weight" is used where the word "mass" is meant. One paragraph, for instance, states that the earth's weight approximates 6×10^{21} tons.

Atlas must have been a very strong man.

I have always supposed the assumption that the earth (taken as a whole) had weight, to be a myth like the familiar picture of Atlas supporting the world upon his shoulders. If a modern strong man should place his shoulders, Atlas-like, against the earth anywhere on its surface, the so-called weight or force of gravity would be not towards the man but away from him in the direction of the earth's center. The earth would uphold the man not the man uphold the earth. Hence, if a child were given a place, not affected by gravitation, to stand upon, it might support the world upon the palm of its hand. This at least is the viewpoint of the average person. T. F. WILLIAMS.

Chicago.

[*It is, of course, true that, strictly speaking, the earth has no weight. The common tendency to use* WEIGHT and MASS *as though they were synonymous led us to follow this usage in the body of the article in question, for the sake of conveying a more definite impression of what it was about. In the article as originally written and set up, there was a final paragraph drawing the distinction, and pointing out that the experiment really led to the determination of mass rather than of weight. This got crowded out in the process of making the type fit the page, and perhaps it was a more serious loss than appeared to us at the time.*—EDITOR.]

Some Wage Philosophy

To the Editor of the SCIENTIFIC AMERICAN:

One of the reasons for the present labor unrest is the belief that wages is a question between the employer and employees to be settled according to the relative strength of each party subject to modifications due to the condition of the industry. In accordance with this belief labor seeks to organize itself as a means of increasing strength, and then uses this strength to increase its wages, whenever possible.

Wages however is not a question to be settled by employers and employees. It is a question that must be settled by labor itself. It is an axiomatic proposition that if one man produces twice as many chairs as another man he is entitled to twice the salary, and if one man displays twice the capacity or skill, energy and industry as another man he is entitled to twice the salary even if they be engaged in different occupations. The fact is that there is a certain amount of wealth created by the producing class and if their salary measures their part in its production each man will be able to buy back that part he has produced.

If on the other hand wages do not measure production or capacity but the relative strength of the men of one industry as compared to others and the relative condition of the industry itself, the part each man will be able to buy back of the wealth produced will not be proportionate to the part he has produced. This state of affairs does a great injustice to those who are underpaid as compared to the others. For example, if we assume that the same capacity is required to do a certain job in carpentry as in plumbing, and if the plumbers, owing to their strong organization and the urgency of their service are able to obtain twice the wages of the carpenter, the carpenter will be deprived of 1/3 his deserved salary or purchasing power.

For, assuming that the wealth to be divided between the plumber and carpenter is 100 units of wealth and the wages of the carpenter, $33.33 1/3 and that of the plumber, $66.66 2/3, the carpenter will have been deprived of $16.66 2/3 or 1/3 of his normal purchasing power.

In order, therefore, to put the wages of each producer on an equitable basis a convention should be called comprising every branch of labor, and they should decide on a scale of wages covering every occupation of distribution and production. They should also form a permanent court to decide on any new matters that may arise and gather information for the use of the next convention. After they have decided upon a scale of wages, this scale should be made binding upon the investing class. And inasmuch as it is to the interest of the investor that each employee should produce up to his salary such a law would automatically be obeyed and enforced.

While it will not make any difference to the country what the standard of wages adopted may be, $1 or $10 a day, it should be made to conform to our present standards in order that those who now own property will not be affected.

Now furthermore when men specialize in order to make possible the maximum production of wealth per individual there is assumed the moral obligation that each man will do his part. Without this assumption specialization and therefore civilization would be impossible. If therefore any set of men refuse to work and break their obligation, the obligation of the rest of society to this class immediately ceases and they have the right to refuse the strikers food, clothing, transportation, etc.

Confining ourselves to the question under discussion, when labor decides on the scale of wages, the producer loses his greatest reason or justification for striking—unfair wages. And if one class of labor is dissatisfied with its wages it cannot with justice or reason strike against its employer for he has nothing to do with wages. On the other hand, if they persist in striking they strike against the united labor of the land, or practically society, and society in turn can quickly bring them to terms by refusing them food, clothing, transportation, etc. Under the above conditions strikes would be inconceivable.

Now the purpose of this letter is to show how each producer can receive his fair share out of the wealth allotted to labor, but the writer knows that the part allotted to labor as a unit, is at present unfair. Inasmuch, however, as this condition cannot be remedied by any system of wages, and as the solution to this question will not affect the above argument this question can be discussed later. JEROME LEVY.

New York

Highways Through the Wilderness

Venezuela's New Link Joining Her Ports with Her Internal Trade Centers

By Harry Chapin Plummer

FEW Americans, perhaps, are aware that in Venezuela, a land of notoriously difficult transportation conditions, the twentieth century trend toward the supplanting of railroads to a large degree by automotive vehicles has received great impetus through the construction of nearly two thousand miles of high-grade modern wagon thoroughfares connecting the seaboard with the leading cities of the interior. Fewer of us would suppose that this system of mountain highways meant anything to American industry save perhaps the opportunity to run up a doubtful account through aiding in their building. In this article Mr. Plummer tells some surprising facts about Venezuela's venture in highway building, and the big lift which it has given to trade with this country.—THE EDITOR.

Ocumare de la Costa, Venezuela's newest seaport and the terminus of one of her trans-mountain automobile highways

SWEEPING improvements in the political, economic and social life of the Republic of Venezuela have been effected within the last few years by the construction, upon a broad and comprehensive scale, of a system of "carreteras nacionales" or national highways totaling, in extent of completed roads, 2,900 kilometers (approximately 1,800 miles). These have been specifically designed to bear the burden of motor transportation of both passengers and freight, as well as of all classes of vehicular and equestrian traffic.

Built primarily with a military objective, these roads already have come to serve the routine needs of peace, while being at all times available for the exigencies of war. They provide a means for the quick mobilization of the Venezuelan army of 50,000 at any of the principal strategic points of the country. Infantry, cavalry or artillery may with equal facility and despatch pass over any of these roads to a given rendezvous. The broad, smooth highways compass distances, grades and defiles that hitherto presented, if not impassable barriers to anything like the quick and flexible movement so necessary to military forces, then at least slow, tedious, dangerous and costly resistance.

Moreover, if heretofore the army suffered a drawback in lack of adequate transportation facilities, the commerce of Venezuela too was woefully handicapped. One of the greatest and most coveted of Venezuela's assets is her magnificent coastline of hundreds of miles on the Caribbean Sea. To realize the serious difficulties under which her rich commerce labored in seeking its egress to foreign markets, it need only be noted that until the completion, during the last decade, of the highway system, with its three separate routes from three chief ports of the republic to the capital and interior centers of industry, the country had recourse only to two railway lines, well constructed, it is true, but offering an indifferent service at a prohibitive tariff with amazingly excessive wharf and terminal charges. The only available alternative to these consisted of "old Spanish trails", up and down the mountainsides, which hazarded the necks of man and beast, walking single file, the only means of locomotion they afforded.

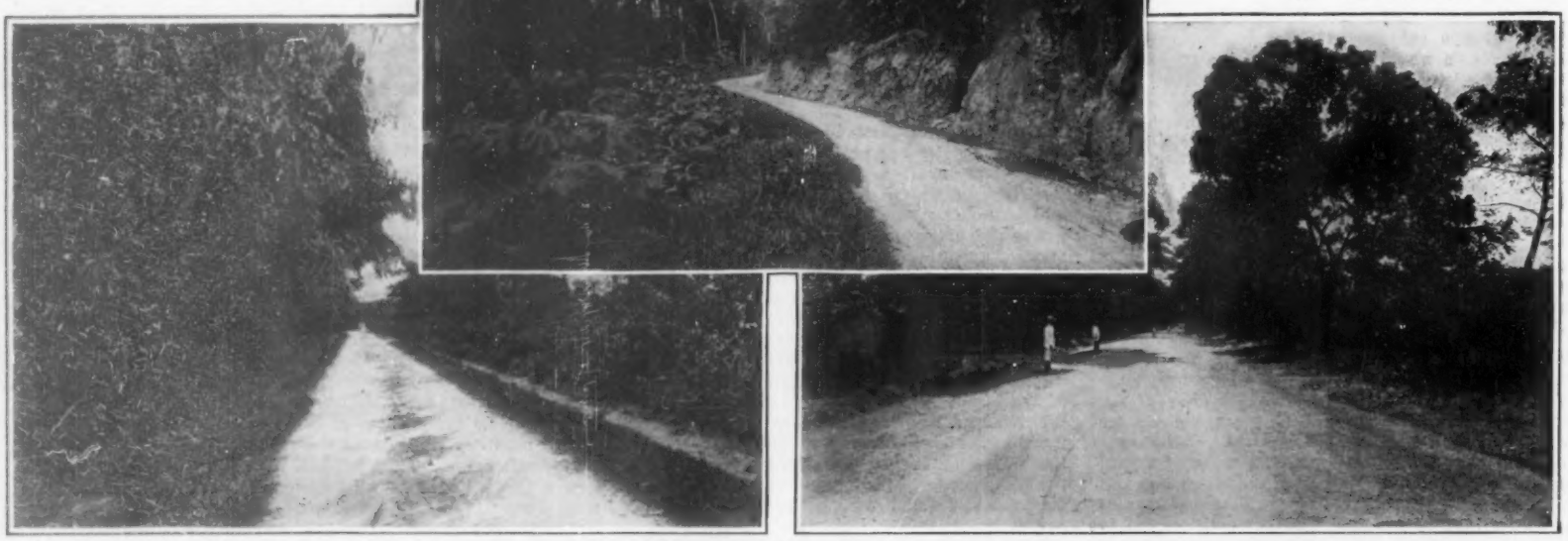
Now not only all manner of merchandise may be whisked from seaport to the interior and vice versa by the redoubtable American motor-truck, but travel from the coast to inland Venezuela, from a punishment, has become one of the world's supreme attractions of motoring.

Ambitious as is the program of road construction that thus has been entered upon, its larger economic significance, not only for Venezuela and her people, but for the principal exporting nations of the world and in particular for the United States, looms up in perspective when it is realized that these highways have been virtually "plotted" to take the place of future railroad building. This might have been resorted to instead of the advancement of the "carreteras nacionales" but for the fact that the railroads of Venezuela, besides rendering unsatisfactory service at exhorbitant tariff rates, had developed all the evils of modern stock jobbing and financial juggling. This condition, extending over a decade or more, eventually came to the head that do all sores, physical, political or financial, in the celebrated controversy which raged about the English corporation that operates the Valencia and Puerto Cabello Railway and finally resulted in the repudiation by the Government of Venezuela, by formal Act of Congress, of an interest guarantee of five per cent per annum upon the company's capital stock. The award by an American arbiter, Frank Plumley, of 25,000 pounds by way of satisfaction to the company—less than a single year's interest—concluded the case.

With respect to the technique of construction and maintenance of the highways of the new system, local considerations and the requirements of the major volume of traffic that may normally move into or out of a given section have been taken carefully into account. On the level stretches of the extensive *llanos* of the interior, advantage has been taken of natural dirt bases for roads that have come to sustain the burden of the enormous production of cattle, grain, corn, coffee, cotton and sugar sent forth from those fertile plains. On the precipitous mountain slopes of the massive watershed that divides the highland *llanos* from the sea, macadam has been in the main resorted to, while in other mountain districts of the republic that form of base has been the rule. In general, American and English principles of roadbed have been employed and great numbers of steel bridges and not a few suspension bridges have been designed, imported and set up by leading American bridge-building corporations.

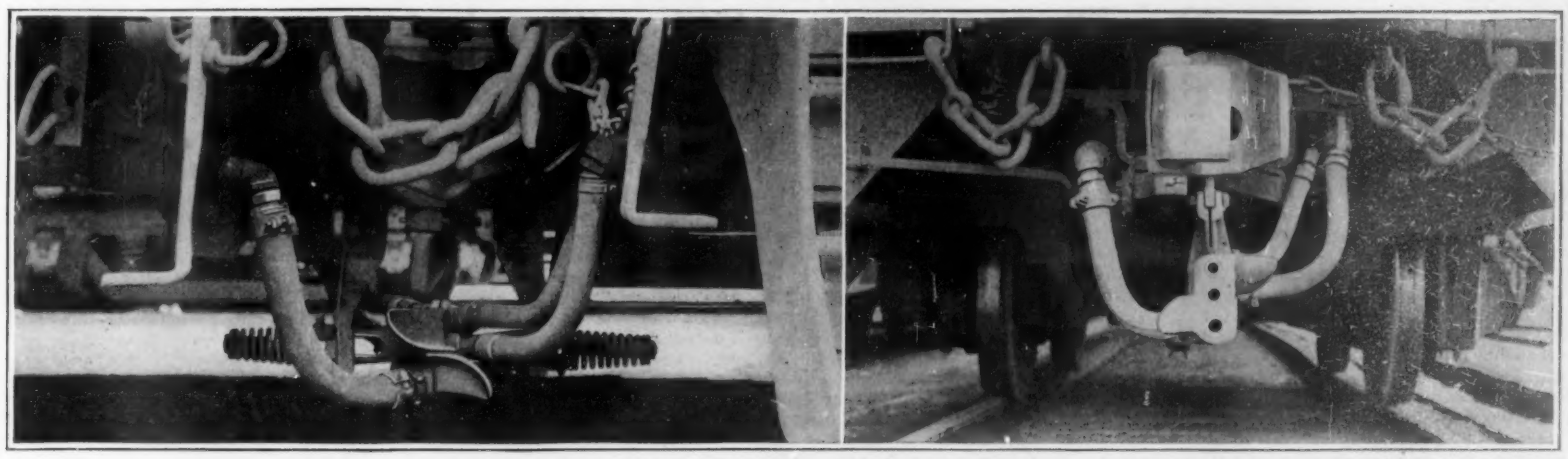
For many smaller bridges and culverts the native cement, of excellent and lasting quality, in which Venezuela abounds, has been utilized in vast quantities; too, the cement has been used in many masonry approaches to steel viaducts and trestles. The building of these smaller cement structures, in their relation to the peculiar topography of the Venezuelan terrain and to the capricious nature of the streams they span, streams

(*Continued on page 288*)



Left: A speeder's paradise in the heart of the mountains. *Right:* Typical stretch of roadway in the State of Aragua, near Maracay. *Center:* Where the road winds among the foothills and breaks through to the sea.

Snapshots of Venezuela's new and modernized system of automobile highways



Left: The automatic connector joined up between two passenger coaches. The gathering prongs on opposite heads alternate so that they will interlock and guide the contact faces to a firm union when brought together. The buffer spring holds the connector heads together against any lurch, sway or swing of the cars. *Right:* Front view of the connector as attached to a passenger car, showing the signal, air-brake and heating-steam ports, from top to bottom, and the position of the gathering prongs.

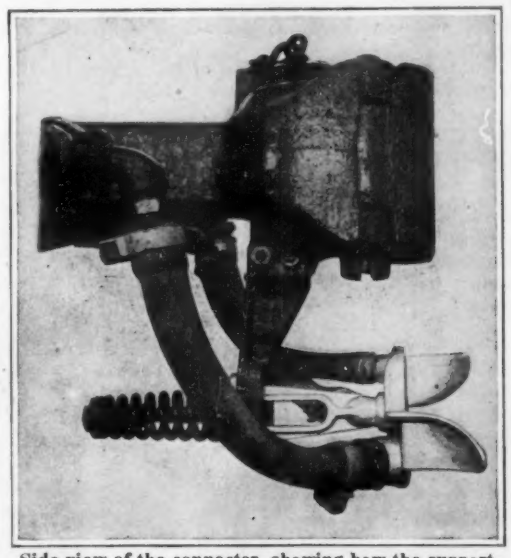
The automatic connector for air-brake hose and other circuits that at present must be completed by hand when cars are coupled

Cutting Out a Railroad Hazard

By S. G. Roberts

AMERICA is still very much a land of promise for the inventor, especially if he have the rare gift of analyzing the practical requirements of a problem. This has been well demonstrated of late in the evolution of a thoroughly workable, rugged, and withal simple apparatus for automatically connecting and disconnecting the heating and airline circuits of railway trains.

For the sake of those not familiar with railroading, let it be explained that though an automatic car-coupler was invented years back to replace the old link-and-pin expedient, which caused death or serious injury to thousands of trainmen who had to go between the cars to effect the coupling, still the hazards persisted. The hose for the air-brake line, and similar flexible connections for the train-signaling and steam-heating services, have severally to be coupled up after the vehicles are brought together; and to do this the yardmen or trainmen are obliged to get between the cars, where their presence may be unnoted by others directing the movement of the train. But the risk to life is not the only reason why the railroad fraternity at large have long desired an apparatus that would automatically join the brake, the air-signal, and the steam-heating circuits when cars come together and similarly disconnect them as the coaches are drawn apart. There are both operative and economic warrants for an efficient automatic hose-connector. To begin with, the disconnecting is all too frequently accomplished by sheer stress as the cars are separated—for one reason or another the trainmen fail to break the connection. If the rubber-and-canvas fabric is not torn the texture is very likely to be weakened. These impaired lengths of hose leak and if not replaced promptly they levy a heavy tax upon the boiler to offset the wastage. Nor does the evil stop here; it is not merely a question of burning so much more coal as a primary source of energy.



Side view of the connector, showing how the supporting bracket is secured to a lug on the under side of the regular car-coupler

The air-brake assembly works in negative fashion.

(*Continued on page 289*)

Welding a Lighthouse's Broken Legs

By Ralph Howard

DURING the arctic winter of 1917-1918 when zero weather paid frequent visits even to the Carolinas, a most unusual accident happened to Wade Point Lighthouse, which is situated one mile from shore in the northeasterly part of Albermarle Sound, N. C. A large ice-floe which had formed in Albemarle Sound became detached by a terrific gale and was driven with great force against the five cast iron columns which support the superstructure of Wade Point Lighthouse in a depth of nine feet of water. So great was the pressure of the ice after it had piled up on one side of the structure, that the columns were bent over in a northwesterly direction and broken through, the columns below the breaks standing at an angle of about 20 degrees with the vertical. The northeast, center and southwest columns broke just above the lower sockets. The southeast and northwest columns broke respectively 18 inches and 6 inches above the socket.

Fortunately the strong iron tie rods underneath which held the supporting frame together prevented the lighthouse from collapsing. Although the lower part of the broken columns had been thrown over into an inclined position, the upper part of the structure, including the lighthouse proper, remained vertical.

The Lighthouse Service was unable, until recently, to undertake any repairs on the lighthouse. During the fifteen months after the accident the station dwelling was not occupied by the keeper, who attended to the light from a nearby city. At the end of this period temporary repairs were made by driving wooden piles and placing supports underneath the structure.

When the question of making a permanent

(*Continued on page 290*)

Left: Preparing one of the columns for the welding operation. *Center:* View of the lighthouse, showing temporary pile construction, with three welds completed. *Right:* A finished weld, necessarily made without alineing the column.

How welding undid the damage which an ice jam wrought on the foundation of a Carolina lighthouse

The Photostat as an Aid to Research

Some Example of the Uses to Which It Has Been Put in One Library

By Howard S. Leach, Reference Librarian, Princeton University

THE photostat is a relatively new invention, but it is already making itself an indispensable tool of research in our larger university libraries. Scholars, both members of the University Faculty and of the Graduate School, are learning of its use and more and more are coming to use it as an aid to their studies.

It is a large commercial camera, intended primarily to reproduce manuscripts and the printed page. Automatic in its adjustments, it is easily handled even by one knowing little of photography, and by means of a prism lens and sensitized paper it makes both the white on black, or so-called negative copy, as well as the positive copy in usable form. In the case of book or manuscript production the white on black copy may serve one's purpose quite as well as the positive copy and thus save half the expense. With pictures and maps, it is better to reproduce twice and secure the positive copy. Once having secured a good negative, as many positives as desired may be made from it. When the photostat is used extensively it has been found better to have a large, fairly well equipped, dark room, with a tank of running water for washing the prints. It has also been found more satisfactory to remove all chemicals from the machine and place them in large pans in the dark room. When this is done it is necessary to have a light-tight box in which the exposures are carried from the camera to the dark room. It is then possible, by a little skill, to develop these exposures in much the same way as in regular photography. While a knowledge of photography is not absolutely essential for reasonably successful work with the photostat, it has been shown conclusively that much better work is turned out if the operator is acquainted with the principles of photography and has some technical skill. The element of judgment enters into the process, both in the exposure and in the developing, and it cannot be denied that where details, as in the reproduction of pictures, are required, skill and technical ability do produce a better result than the mere automatic working of the machine.

It has been stated that on the average a candidate for the degree of Doctor of Philosophy uses at least two hundred volumes in his research for his thesis. If a library possesses these volumes, it is not a difficult matter for the literary student to use them by means of note-taking. If, however, the books are rare and it entails much travel to consult them, the photostat comes to his rescue and at a reasonable cost reproduces the book in as usable copy as the original and often makes an improvement upon it.

The photostat is now being used not only to reproduce books and manuscripts, as was its original purpose, but it is being used to reproduce maps, charts, pictures, and even small museum objects. It is of the highest importance in preserving fragile and deteriorating books and manuscripts, in that it reproduces a copy for use and allows the original to be put away safely where it need not be used except in extreme cases.

As an aid to research the use of the photostat probably cannot be better illustrated than by a case that has come under my observation. In this case an art student was doing graduate work in Christian iconography of the Carolingian period, with special attention to monuments in ivory and metal work. It was his task to collect reproductions of all of the metal work and ivories extant in that period as a basis for his thesis. These pictures were found in books.

Probably three hundred volumes were consulted to obtain the specimens sought. It will readily be seen how difficult a task it would be to compare examples of Carolingian art scattered through three hundred volumes, if the comparisons had to be made from volume to volume. What this graduate student did was to find the best plate of a given ivory or piece of metal work and have this reproduced by the photostat.

The reproduction was then mounted on cardboard of a certain stated size and filed in a case. When this process had been repeated for all the examples to be found, he had in one small compass all of his foundation material for his thesis. It was in a most workable condition and always at his service. From an almost impossible condition of being forced to use three hundred volumes in making his comparisons, he now had them in this compact, easily used form, right at his elbow, and could then begin his researches from other angles. This is only a case in point and is duplicated in other departments, especially wherever specimens or pictures, charts, maps, or other data of a pictorial nature are used.

The photostat is of great service in research work in reproducing exact copies of a manuscript or book. A copy of a manuscript by a scribe can never be said to be surely correct, while the photostat cannot alter or leave out a single phrase. The cost of reproduction by photostat is also less than that of a copyist. A certain professor of history desired to work with a pipe roll.

To this end, he hired at a cost of $35, a very small portion of the pipe roll in question copied by a professional copyist, and this work was verified by the keeper of the rolls so that it could be relied upon as reasonably accurate, but he could today have the entire pipe roll copied by means of the photostat for much less than $35, and it would be in an absolutely accurate and enduring form.

A reproduction from a Book of Hours for the study of the miniature paintings within the initials

With old books which are found very difficult to read, owing to the yellowing of the page or of small print, the photostat is again of great use, since in the reproduction the page comes out a great deal whiter than the original and the scholar may have his text enlarged to the size he can most conveniently use. There have been many cases in which the legibility of a manuscript has been greatly improved by an enlargement in the reproduction. In the case of some rare manuscripts and papyrus, where there is danger of ultimate destruction through deterioration, the photostatic copy preserves the document for future generations. When pictures or specimens of hand writing, as in a course in palaeography, are the materials used in study, the photostat may be used to furnish each student with copies of the materials where they are not available in convenient book form or are too expensive to permit of generous availability.

In the study of palaeography, where a large number of specimens of handwriting is shown in early manuscripts and in inscriptions, the photostat again plays a large rôle in furnishing copies both from the originals and from plates in books for the use of the professor and graduate student.

In the Engineering Department the photostat has proved useful in making copies of charts and drawings. Architectural or machine drawings can be made several sizes larger than the author wishes the final draft to be and then placed under the photostat and reduced to the size required. This reduction brings out all the lines in very sharp contour and makes a much finer product than the original. Another advantage of using the photostat in reproducing line drawings is the ability to leave out of the negative any portion of the drawing desired by simply covering up the undesired portion with black paper. Thus from the same negative several sets of drawings, each different from the other, may be made as desired. The reduction of large maps to a convenient size for use in the field is an obvious advantage, while on the other hand, a smaller may be greatly enlarged for classroom use. Both the element of time and labor saved in these operations is great.

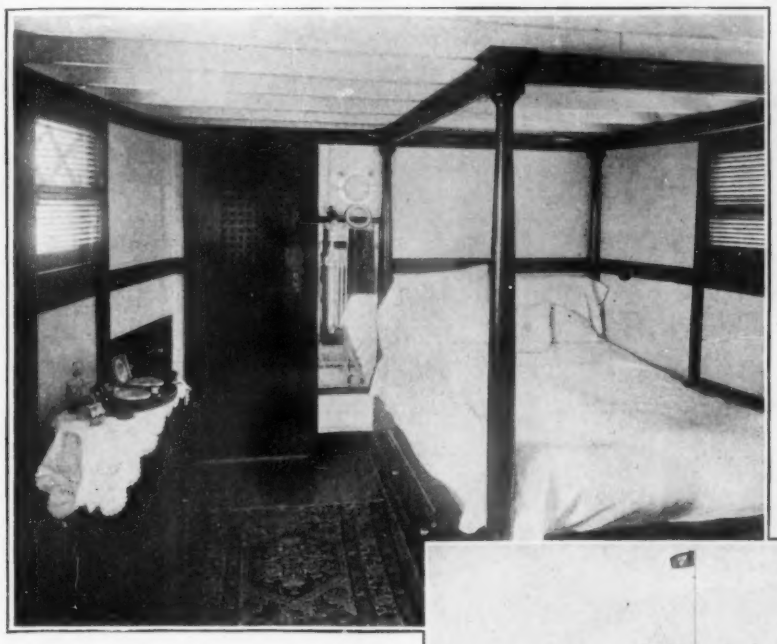
During the present European war there was presented to the University Library a large collection of war currency as used in France, Germany and Belgium. This money was systematically reproduced by the photostat and bound up into a folio volume. Recently a member of the University was writing an essay on war currency and this book was placed in his hands. It was much more convenient for him to use than the actual currency itself and at the same time prevented the wearing out or loss of the originals.

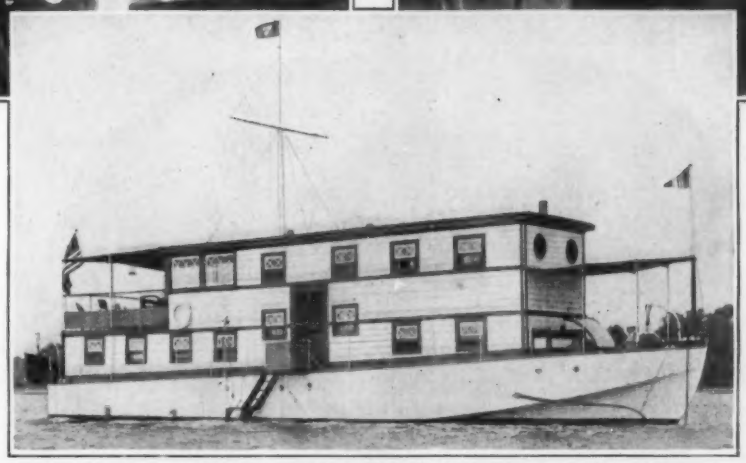
When a manuscript or book is unique there is always a danger that it may be stolen, and hence lost to the world of scholarship, or it may be burned or otherwise destroyed and lost forever. When it has been copied by the photostat in perhaps many copies and widely scattered throughout the libraries of the world, the danger of its loss becomes remote. It is the duty of any library possessing a unique manuscript or book of any value whatever to have it reproduced by the photostat and the reproduction sold to other libraries. It is only in this way that we can be reasonably sure that valuable documents and storehouses of our culture and learning will be saved permanently from destruction.

Recently the Princeton University Library acquired a large collection of books on Egyptology. With this private library came its catalogue, admirably done from the scholastic point of view but the catalogue cards were much larger than the regular international library size, and hence would not fit into our catalogue. It was estimated that to recatalogue by the usual methods would cost several hundred dollars, to say nothing of the difficulty of handling hieroglyphics and Hebrew language. It was finally decided to photograph these cards by means of the photostat, reducing them to the regular card catalogue size. This process reproduced the original cards, with all their fine Hebrew and hieroglyphic characters in a size suitable to be inserted in the University Library catalogue and at a very nominal cost, not more than one-fourth of the estimated cost of the regular method. Here again the time element was a big factor. The cards were in the catalogue ready for reference within a very small fraction of the time it would have taken to copy them on the typewriter.

The Manuscript Room contains some hundred or more Oriental prayer rolls, which require for their mere identification and cataloguing the knowledge and skill of an expert orientalist. Experts in Oriental languages are comparatively few, and the task of bringing together the scholar and his material is not an easy one. When these prayer rolls have been copied by the photostat in whole or in part, they may

(Continued on page 291)





Left: **Double stateroom with four-poster bed.** *Right:* **Living room on upper deck, with open fire place.** *Below:* **The airplane carrier built during the war and now converted into a houseboat.**

Houseboat built on an airplane carrier

Changing an Airplane Carrier Into a Houseboat

ONE of the many devices which were developed during the war for the naval airplane service was a small steel pontoon for carrying a seaplane. An illustrated description on one of these, showing an airplane in course of transit, appeared in the SCIENTIFIC AMERICAN of March 29th, 1919. The term "pontoon" is perhaps a misnomer, for the reason that the craft is built with a V-shaped bow of the type which has come into use in modern high speed motor boats. The hull is 58 feet overall, with 16 feet beam, and has a maximum draft of only a few feet. It is designed especially for towing, the purpose being to draw the seaplane up onto the inclined ways in the center of the boat, which is then taken in tow by tugs, destroyers or converted yachts, as the case may be. The conclusion of the war found the Jacob's Yard with a few of these boats on its hands, and the owners, recognizing the possibility of these craft for business purposes, have converted one of them into a commodious houseboat which has been named the "Briny."

The hull is of steel throughout, and it contains five semi-watertight bulkheads. Below the main deck, there is a store room for trunks, et cetera, and also four water tanks, with a capacity of 750 gallons. These are connected with another set of tanks on deck which hold about 100 gallons with gravity flow to the fixtures below deck. All of these tanks take rainwater from the roof of the house. This is a perfect and thoroughly practical arrangement, which provided ample water supply last season for a party of six people living aboard.

In the storage room below there is a hot water heater connected with the radiators in the living quarters on the main deck. There is also a generator driven by a 2-horse-power gasoline motor which charges batteries for the electric light system. The plumbing is in accordance with the regular yacht practice, with fixtures of modern type, and as they are all above the water line, they are simple in operation.

Forward, there is a deck covered by an awning, and the accommodations are as follows: forward on the main deck is a large double stateroom with four-poster double bed, closets, built in dressing table, and built-in drawers and lockers. Connected with this room is a large bathroom. A passageway leads from this to another double stateroom, with two built-in four-poster beds, and at the extreme after end of the boat is another double stateroom with two built-in berths, closets, lockers, et cetera, and between these two rooms is a second bathroom.

On the upper deck is a large living room with an open fireplace and just aft of this room is a kitchenette fitted with icebox, sink, food lockers, et cetera. The deck aft is partly enclosed by glass at the forward end, and the extreme after end of the deck is covered by an awning. The finish throughout is white and mahogany, and gray and mahogany in the living room. The 14-foot boat is carried on the davits at the transom.

"Shamrock IV" and "Vanitie" in Fire Peril

THERE are few fires that burn more quickly and with fiercer heat than a fire at a shipyard, and the terribly destructive conflagration which took place at Robert Jacob's yard at City Island in the early morning of February 25th proved what quick havoc can be wrought among costly racing craft when once this red terror breaks forth and is driven by a brisk wind. The fire started near midnight and was probably due to defective wiring. When the owner reached the yard, the whole of a new two-story building measuring 100 x 200 feet, which was used as an office and joiners' shop, was a roaring furnace. To leeward of the building there were stored for the winter several of the most famous American yachts, including some of the noted cup winners among the schooners and sloops. Among these were the Herreschoff 145-foot steel schooner yacht "Queen," and the 150-foot steel schooner yacht "Mystery." Besides these were some ten other yachts, many of them of large size and great value. Astern of the two racing schooners lay the "Vanitie," one of the yachts built for the defense of the America's cup, and at the far end of the group of yachts was the new wooden shed which had been built to enclose the challenging yacht "Shamrock IV."

The wind was blowing from the burning building right across the group of yachts, and the flames spread with great rapidity, rendering it quite impossible for the local fire company to save any of them. Consequently, its efforts were directed to drenching the walls of the "Shamrock" shed with water and keeping the "Vanitie" well wetted down. It was this that saved the challenger and incidentally prevented another postponement of the international races. Meanwhile, a power boat stationed at 98th Street, New York, responding

(Continued on page 292)

This shows how the wooden yachts were swept away by the fire

The fire burned all the craft lying between "Vanitie" and "Shamrock IV"

Correct
AUTOMOBILE LUBRICATION

GARGOYLE

Mobiloils

A grade for each type of motor

Gargoyle Mobiloils for engine lubrication are:

Gargoyle Mobiloil "A"
Gargoyle Mobiloil "B"
Gargoyle Mobiloil "E"
Gargoyle Mobiloil Arctic

The chart below indicates the grade recommended by the Vacuum Oil Company's Board of Engineers. The recommendations cover all models of both passenger and commercial vehicles unless otherwise noted. If your car is not listed in this partial chart, send for booklet, "Correct Lubrication," which lists the correct grades for *all* cars.

AUTOMOBILES	1915 Models		1916 Models		1917 Models		1918 Models		1919 Models	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Allen	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Auburn (4 cyl.)							A	Arc	A	Arc
Auburn (6 cyl.)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Auburn (6-66)					A	Arc	A	Arc		
" (6-66) Twin-Ignition			A	Arc						
Autocar (4 cyl.)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Brisco	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (8 cyl.)							A	A		
Buick	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Cadillac (8 cyl.)	A	A	A	A	A	A	A	Arc	Arc	Arc
Case	Arc	Arc	Arc	Arc	A	Arc	A	Arc	A	Arc
Chalmers			A	A			Arc	Arc	Arc	Arc
" (6-40)							A	Arc		
" (6-50)	A	A			A	A	A	A		
Chandler Six	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Chevrolet	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (4 cyl.)		A	A	A	A	A				
" (F.A.)	A	Arc	A	Arc						
Cole							Arc	Arc	Arc	Arc
" (8 cyl.)	A	A	A	A	A	A	A	A	A	A
Cutting-Sun									Arc	Arc
" (6 cyl.)	A	A	A	A	A	A	A	A		
Dort	Arc	Arc	A	Arc	A	Arc	A	Arc	Arc	Arc
" (Model C)					A	Arc	A	Arc	A	Arc
" (1 and 3½ ton)	A	A	A	A						
Dodge Brothers	A	Arc	A	Arc	A	Arc	A	Arc	E	E
Ecrit	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Federal	Arc	Arc	A	A	Arc	Arc	Arc	Arc	Arc	Arc
" (Mod. 5-X)			A	A	A	A				
Federal (special)			Arc	Arc						
Fiat			B	A	B	A	B	A	B	A
Ford	E	E	E	E	E	E	E	E	E	E
Franklin	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Grant	A	Arc	A	Arc	A	Arc	A	Arc	Arc	Arc
" Cont'l	Arc	Arc								
" (12-valv'd)	A	Arc								
Haynes	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (11 cyl.)	A	A	A	A	A	A	A	A		
Harley							Arc	Arc	Arc	Arc
" Super Six	A	Arc	A	Arc	A	Arc	A	A		
Hupmobile	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Kelly Springfield	A	A	A	A	A	A	A	A	A	Arc
King									A	Arc
" (8 cyl.)	A	A	A	A	A	A	A	A	Arc	Arc
" Commercial			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Kissel Kar	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (Model 48)							A	A	A	A
" (12 cyl.)			A	A	A	A				
Lexington	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Liberty Truck			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (Mod M					A	Arc				
" (Mod MW					A	Arc				
Locomobile	A	E	A	E	E	E	E	E	E	E
McFarlan			A	Arc	A	Arc	A	A	A	Arc
McLaughlin	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
McLaughlin (Mod. E6)	A	A	A	A						
Madison			A	Arc	A	Arc	A	Arc	A	Arc
" (8 cyl.)					A	A	A	A		
Marmon	A	A	A	A	A	A	A	A	A	Arc
Maxwell	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Mercer	A	A	A	A	A	A	A	A	A	Arc
" (12-70)									Arc	Arc
Mitchell	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (8 cyl.)							A	A		
Moline-Knight	B	A	B	A	A	A	A	A	A	A
Monroe			A	Arc	A	Arc	E	E	A	Arc
" (Mod. M6)			A	A	A	A				
" (Mod. E)	A	A								
Moon			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Nash	A	Arc	A	Arc						
" (Mod. 681)			A	A						
" (Quad)	A	A	A	A						
National	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc	A	Arc
" (12 cyl.)	A	A	A	A	A	A	A	A		
Nelson	A	A	A	A	A	A				
Oakland	A	A	A	A	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl.)							A	A		
Oldsmobile (4 cyl.)	A	Arc					Arc	Arc	Arc	Arc
" (6 cyl.)	A	A	A	A	Arc	Arc			Arc	Arc
" (8 cyl.)	A	A	A	A	A	A	A	A		
Overland	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Packard									A	Arc
" (12 cyl.)	A	A	A	A	A	A	A	A		
" Commercial	A	A	A	A	A	A	A	A	A	A
Paige (4 cyl.)									A	Arc
" (6 cyl.)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (6-46)							A	Arc	A	Arc
" (6-46-70)					A	Arc				
" (6-48)	A	Arc	A	Arc						
Paige (Cont'l)	Arc	Arc	Arc	Arc						
Paterson	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Peerless	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl.)	A	A	A	A	A	A	A	A		
Pierce Arrow	A	A	A	A	A	A	A	A	Arc	Arc
" Cont'l	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Premier	A	A	A	A	A	A	A	Arc	A	Arc
Regal	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl.)							A	A	Arc	Arc
Renault (French)							A	Arc	A	Arc
Reo	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Risser	A	E	A	E	E	E				
Saxon	E	E	E	E	E	E	E	E	E	E
Selden	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (¾ ton)					A	Arc				
Simplex Crane			A	A	A	A	A	A	Arc	Arc
Stearns-Knight	B	A	B	A	A	A	B	A	B	A
Studebaker	A	Arc	A	Arc	A	Arc	A	Arc	Arc	Arc
Stutz	A	A	A	A	A	A	A	A	A	A
Velie (4 cyl.)									A	Arc
" (6 cyl.)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (1 & 1½ ton)	Arc	Arc	Arc	Arc						
" (½ ton)	A	Arc	A	Arc						
Westcott	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
White	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (Sixteen Valve)	A	A	A	A	A	A				
White (¾ ton)	A	A	Arc	Arc						
Wolfe-Knight	B	A	B	A	A	A	B	A	B	A
Wolfe-Lee	A	Arc	Arc	Arc	Arc	Arc				
Winton	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc

Many Times the Proof

What the Automobilist can learn from the User of Motor Trucks

THE average motor truck consumes in a year, due to greater mileage and heavier duty, many times as much gasoline and many times as much lubricating oil as the average passenger car.

The heavy duty conditions under which motor trucks operate subject the oil to a more severe test than in passenger car operation. Poor oil shows up its inferiority. Gargoyle Mobiloils show up their superiority, economy and efficiency.

Hundreds of tests are made every year under engineering supervision to determine comparative oil values based on *engine results.*

In test after test of this kind, Gargoyle Mobiloils demonstrate their superiority. When compared in a scientific way, Gargoyle Mobiloils show greater economy in use, greater freedom from carbon and greater protection to the frictional surfaces.

In Melbourne, Australia, the engine of one omnibus using Gargoyle Mobiloils was taken down after running 100,000 miles. All frictional surfaces were found in perfect condition. No wonder that American supremacy in Scientific Lubrication is recognized in all parts of the globe.

Only one thing counts—*engine results.* Physical tests of the oil do not forecast *engine results.* Home made tests cannot indicate *engine results.* The only valuable test is the test of service.

Maximum *engine results* are secured only when scientific lubrication is employed. Scientific lubrication means the use of an oil that meets with scientific exactness the lubricating requirements of the engine. The oil must be correct in body and high in quality to meet the test of service.

There are between 190 and 490 frictional surfaces in your engine. Every one must be protected by a scientifically correct oil film if you are to get *engine results.* The Chart will solve this problem. It is printed in part on the left. A booklet, "Correct Lubrication," containing the complete Chart will be mailed you on request.

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DOMESTIC BRANCHES:

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VACUUM OIL COMPANY *Specialists in the manufacture of high-grade lubricants for every class of machinery. Obtainable everywhere in the world* NEW YORK, U.S.A.

What Is a Silo?

An Invention of the Nineteenth Century and the Place Found for It in Farm Economics by the Twentieth

By Arthur L. Dahl

THE silo is the preservation jar for stock, for just as the fresh fruits and vegetables are canned for the table, so the succulent grasses and crops of summer are preserved for feeding stock in winter. The use of silage has revolutionized the dairy industry, for it enables farmers to feed cows the kinds of feed needed to keep up milk production during the months when green pasturage is not available. The abundant milk flow obtained from June pasture is, to a large extent, due to the juices in the grass; the silo provides a similar juiciness during winter, when pasture is not available. It promotes the health of dairy cows by providing the coarse feed to which the digestive system of the cow is accustomed. Cows like silage, and no other feed combines so well with dry hay and grain to produce much milk at little cost.

Tractor driving a silo-filler that blows the ensilage up a 40-foot spout and into the silo

The silo enables the general farmer to utilize more fully all the growth produced on his land. It offers the best way of preserving the mature corn crop, 40 per cent of the food value of which is in the stalks and leaves. It also saves the crop which, for any reason, must be harvested before it is mature. When the farmer harvests only the ears of corn he loses nearly half the value of the crop; when he puts it in the silo the loss is very small. When drought, frost, or insects threaten a field of corn before it is ripe the entire crop may be lost unless the farmer has a silo ready in which to preserve it.

The idea of the silo is not a new one, for according to historians the ancient Greeks and Romans used underground pits to preserve grain and green feed. The same thing has been done for hundreds of years in northern Europe, where the uncertainty of the weather and the low temperature make it difficult to cure hay. When the pilgrim fathers first set foot in this country they found the Indians preserved their winter's supply of maize by burying the grain in deep pits. The first silo built above ground in this country was constructed in Michigan in 1875.

Silos are, as a general rule, tall structures built of either wood, concrete, brick, stone, or steel. While there are a number of ready-made silos on the market, a great many in use are home-made, as it is possible to secure detailed instructions for erecting the various types from the State Agricultural Colleges or the Department of Agriculture. There are certain fundamental requirements which must be observed to secure best results.

The walls must be impervious to air and water. The making of silage consists largely in a fermentation process. Bacteria pass into the silo with the green fodder and after a short time begin to multiply there, favored by the presence of air and moisture and an abundance of feed material, especially soluble carbohydrates. The bacteria feed upon these substances and break them up into acids, like lactic and acetic acid, and simple gaseous components, mainly carbon dioxide and water vapor. Considerable heat is evolved in this process. Most of the bacteria found in silage cannot live in the absence of oxygen, and if oxygen in the air spaces in the silaged mass is able to escape, the bacteria die and the fermentation process ceases, unless more air is admitted. Accordingly, it is important that the silo be air tight.

The silo wall must also be water-tight so as not to allow moisture from the green fodder to escape, as the silage would otherwise dry out, and molds and yeasts would be able to grow therein and cause the silage to spoil.

The silo must be deep, so that the entire mass may be under considerable pressure. This will cause it to pack well and will leave as little air as possible in the interstices between the silaged fodder, thus reducing the losses of feed materials to a minimum. The early silos built in this country and abroad were shallow structures, often not over 12 to 15 feet deep, and the loss of silage was excessive. As the silage packs better in a deep silo than in a shallow one, the former will hold more silage per cubic foot than the latter.

The silo must have smooth, perpendicular walls, which will allow the mass to settle without forming cavities along the wall. In a deep silo the fodder will settle several feet during the first few days after filling. Any unevenness in the wall will prevent the mass from settling uniformly, and air spaces thus formed will cause the surrounding silage to spoil. Some owners coat the interior of the silo with paraffin, and this protective covering not only renders the sides air and water proof, but it presents a smooth surface for the silage and aids in packing it tight.

The walls of the silo must be made rigid and strong, so as not to spring when the green mass settles. The outward pressure in the silo during the settling of the mass is considerable, and increases with the depth of the silage at the rate of about 11 pounds per square foot for every foot in depth of silage. Because of this great pressure it is difficult to make good silage in large rectangular silos, since the walls of such silos always spring more or less under the pressure of the silage and this seldom keeps as well in them as in silos whose walls cannot spring. In the round wooden silo every board acts as a hoop, and as the wood does not stretch much lengthwise, there is little danger of spreading the walls in such silos. Both on this account and because of economy of construction, silos of the round type are practically the only kind built at the present time in this country.

Almost any green crop can be made into silage successfully, but corn is the principal crop used, as silage made from it contains a high percentage of digestible nutrients, has a good flavor, is very palatable, and will keep in good condition for years. In most parts of the United States more food material can be obtained from an acre of corn as silage than from an acre of any other crop that can be grown. Corn is more easily harvested and put into the silo than crops like rye, clover, cowpeas, or alfalfa, and when cut for silage the maximum quantity of nutrients is preserved. Experiments made by the Department of Agriculture have shown that corn, when siloed, lost 15.6 per cent of the dry matter, against 23.8 per cent when cut for fodder and cured in the field. Moreover, there is less waste in feeding silage than in feeding fodder, since good silage properly fed is all consumed. Silage has certain laxative properties which keep the digestive organs of animals in good condition. Live stock receiving some form of succulent feed have keener appetites, softer and more pliable skins, and a more thrifty, healthy appearance than those fed exclusively on a dry ration.

Corn for silage is harvested in the same stage of maturity as when intended for fodder, that is, the kernels should be dented in the rough stage, and the lower leaves of the stalk turning brown. The nearer the corn is to maturity the more valuable for silage, provided there is enough moisture to make the silage ferment properly. Cut in proper season there is enough moisture in the corn crop to make good silage, but if the crop has become too dry before it is put into the silo, water must be added. The water is added either directly into the silo or by running it into the blower as the corn is cut.

The material to be made into silage is first run through a cutting machine before being elevated or blown into the silo. The usual length of cutting varies from one-fourth of an inch to one inch. The longer the cut the more rapidly the corn can be run through the cutter and the less the cost of filling. The larger pieces do not pack so well, and there is more waste in feeding. Cut to pieces ranging from one-half to three-quarter inch the material packs well in the silo, the silage comes out in better condition and there is less waste in feeding, although the first cost of filling is a little more.

As the corn comes from the blower it usually falls in one particular spot in the silo and the stalks and leaves are not evenly distributed unless a distributer is used. Usually one or more men are used to spread and tamp the silage. As the top layer of silage is usually spoilt, it is customary to place a covering, several feet deep, on the top, made from

(Continued on page 292)

THE city dweller, who years ago was accustomed on his journeys through the country districts to seeing the good old-fashioned rectangular barn of loosely-put-together timbers, now finds that his eye is mainly filled, when he ventures into the agricultural region, by trim, business-like structures that look like a cross between a dinner-pail and a gas-tank. Doubtless in many cases he is quite in the dark to know why farm architecture has so suddenly and so universally assumed this cylindrical aspect. And it is to be suspected that familiarity with what the silo does has led the farmer to ignore more or less the interesting question of how it does it. Accordingly it would seem that alike for the man who knows what a silo is and the man who does not, Mr. Dahl's discussion may prove of interest.—THE EDITOR.

Cutting silage for storing in silo which has been built into the barn

Ecuador Contributes a Wood That Is Lighter than Cork

By James Anderson

SCIENCE has scored again! A tree which heretofore has been regarded as useless, has now been found to be one of the most valuable products of nature. It is balsa (meaning raft) wood, which is rapidly supplanting the old fashioned cork life-savers. Balsa wood is lighter than cork, and strange as it may seem, is as durable as spruce!

Many years ago Captain A. P. Lundin was a seafaring man. In those days the life saving appliances aboard the ships were not what may be termed perfect, and Captain Lundin, looking always for the safety of his passengers and his crew, set about to remedying any defects in the life saving appliances that existed. He experimented. Some faults were remedied. Some still remained, of course, among which was the inability of the old-fashioned davit bars to launch a life boat as quickly as possible.

In 1906 Captain Lundin gave up the sea and devoted himself to the development of marine life saving equipment.

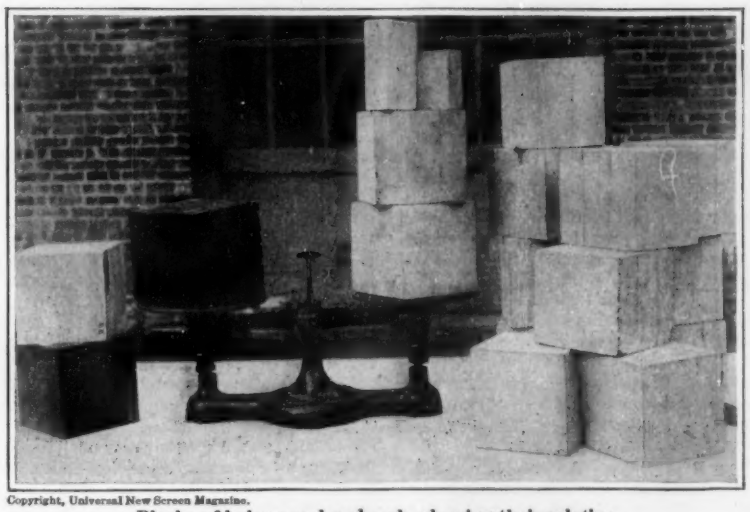
He became identified with a company to take over certain patents pertaining to life saving appliances, among which was a new-type davit, which makes it possible for two men to launch a life-boat safely in the roughest of seas.

Here is where balsa wood comes in. Captain Lundin found that something more efficient was needed than the ordinary cork life savers. He remembered a wood used by the natives of Ecuador for building their rafts. The wood was lighter than any other, and it was possible for a man to carry a log with ease. Captain Lundin immediately secured a sample of this wood, but after many experiments almost decided that it would not do. Although it was much lighter than cork, it was difficult to prepare, it decayed rapidly and gradually absorbed water. Many attempts were made to treat the wood, but without success. Finally however, a process was perfected whereby a waterproofing mixture could be brought to the center of any piece of timber, coating the cells and ducts with an extremely thin permanent film. The treatment was developed and an important business was built around the large elliptical ring-shaped rafts of balsa, which are of sufficient dimensions to float safely from 14 to 60 persons.

The scientific name of balsa wood is *Ochroma lagopus*. The tree, in appearance, resembles the North American cottonwood, the bark being fairly smooth, while the wood looks quite like pine. The leaves are very large on a young plant, often two and three feet across, growing smaller as the trees grow older.

In cutting cross sections of the balsa wood no annual rings are visible, for, as in many other tropical woods, the growth is continuous the year round. When dry, balsa weighs only 7.3 pounds per cubic foot, while cork weighs 13.7 pounds to the same space.

In spite of its very light weight, tests made at the Massachusetts Institute of Technology gave the strength of balsa wood as being fully one-half of that of spruce. This strength comes from the structure of the wood which is made up of large barrel-shaped cells as there is almost no lignification in the tissues, the wood is practically pure cellulose.



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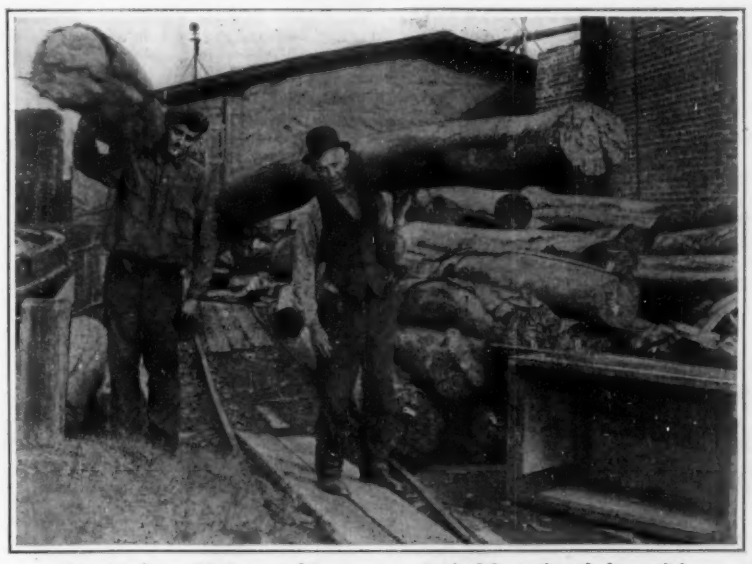
Blocks of balsa wood and cork, showing their relative bulk for a given weight



Carrying logs of balsa wood is no great physical feat, since balsa weighs only 7.3 pounds per cubic foot

The most astonishing feature about the tree is the rapidity of its growth. The United Fruit Company has records showing that trees have grown from the planting of the seed to a height of thirty-six feet in one

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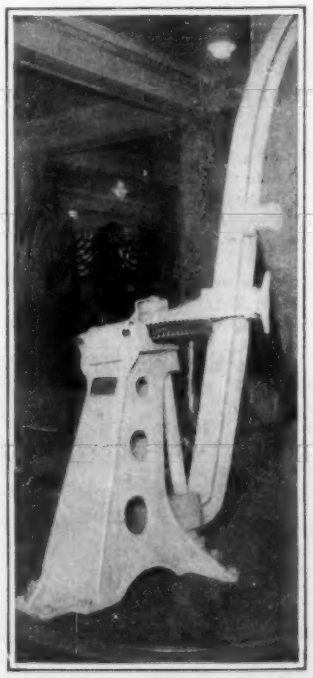
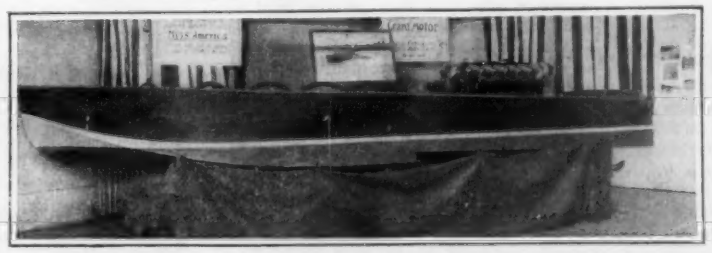


New type of derrick operated through worm gear



"Miss America"; Harmsworth Cup challenger; speed, 70 miles per hour. This boat is equipped with a 400 horse-power Liberty motor

"Miss Detroit III", planing at full speed. This boat is practically the same as "Miss America"

Some Features of the American Motor Boat Show

By "Nauticus"

THE immediate impression formed upon the mind of a visitor to the American Motor Boat Show was of the exceedingly high quality of the exhibits. The development of motor boating in America has gone along side by side with that of the automobile, and if the motor boat industry does not compare with the automobile industry in respect to quantity, it is well able to hold its own in the comparison with respect to workmanship and general all-round quality. Naturally, popular interest centered in the remarkable little craft "Miss America," which has been built as one of three American challengers which will be taken to the other side of the Atlantic to compete off the Isle of Wight for the Harmsworth trophy. The public is thoroughly familiar with the "Miss Detroit" racing craft, which of late years have pulled up the speed record in competition to practically 60 miles per hour. "Miss America," except for slightly enlarged dimensions, is practically a sister boat to "Miss Detroit III" of which we show a photograph taken when she was running at full speed. Mr. Smith, the well-known builder of these boats, informs us that on private trials "Miss Detroit III" has touched 65 miles per hour. She is equipped with what is practically a Liberty motor, although, in agreement with Government regulations, the motor is not given the name "Liberty," but is known as the Grant motor. It is built, however, entirely of Liberty parts, and is practically identical with the engines which did such fine work in many fields of activity during the war.

"Miss Detroit III" was 20 feet in length and 6 feet in beam, and was built with a single step at about her mid length. "Miss America" is 22 feet in length by 6 feet 6 inches beam, and she also is equipped with a Grant motor built of Liberty parts. In trials made over the measured course at Algonac on the Detroit River, a few miles from Detroit, she has made a speed of 72½ miles per hour, and it is the expectation of her builder that he will be able to get 75 out of her in smooth water when she is fully tuned up.

There is no question of the accuracy of the course on which the trials were made. It extends between two docks on the river, the distance between which was carefully measured on the ice with an engineer's chain. With regard to the name of the motor, it is interesting to note that the Government has trade-marked the name "Liberty" as applied to internal combustion motors. This was done on June 17, 1919. Hence for other than Government purposes, a Liberty motor must be known by some other name.

The interest of this exhibit was greatly enhanced by the fact that Mr. Chris Smith, the builder, for the first time allowed the interior of the hull to be viewed by the public. The construction is amazingly light. The 400-horse-power motor is mounted on two longitudinal timbers, an inch and a quarter thick by about fifteen inches deep, which extend from the after end of the engine well up into the bow. The propeller shaft has a drop of about ten degrees, and when the boat is at full speed, only about six inches of the bottom

(Continued on page 292)

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

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An attachment which helps focus the hand camera

Taking the Guess Out of Photography

BECAUSE of its compactness and ease of handling, the hand camera has come to be a favorite with the press photographer as well as the amateur. However, the hand camera generally has a focusing scale which calls for a careful estimate of the distance between the lens and the subject, and it often happens that a miscalculation results in a blurred, out-of-focus negative.

It has remained for one of the New York press photographers to devise a simple attachment for any form of hand camera, which absolutely takes the guess out of hand-camera photography. This attachment consists of two metal tubes which telescope into one another, a lens of equal focal capacity to that of the camera, and a ground glass screen. The tube holding the ground glass screen is attached to the body of the camera, while that holding the lens is attached to the front board. As the camera is racked back and forth the focus can be studied on the tiny ground glass screen, which also acts as a finder. And whatever appears on the finder will appear on the negative—and with the same degree of sharpness. The attachment can be removed in order to fold up the camera.

Banishing the Grasshopper

GRASSHOPPERS threatened to ruin the crops of a large stock farm in the Connecticut River Valley during a recent summer, but the enterprising owner found a way to banish the pests.

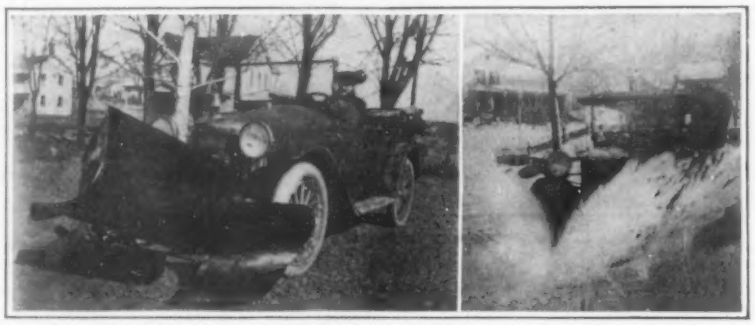
Removing the teeth from a discarded horse rake he replaced them with a box-like framework of two-inch joists. The top of the frame, which was pitched like a piano box top, was fastened securely to the top of the axle of the rake, within two inches of each wheel. On the lower part of the frame, six inches from the ground, he fastened two shallow pans eighteen inches wide. The pair just fitted the length of the frame. Pieces of zinc were hooded up from the sides of the pans, curving inward a few inches over the tops, so they would hold liquid. Wire screening was fastened around the frame from the pans to the axle.

A home-made machine for catching and killing grasshoppers

The pans were filled with water and a little kerosene oil poured on the top. As the machine was drawn over the land grasshoppers would jump into the curved screening, then fall into the pans where the oil killed them. Several barrels full were caught in a short time and the crops were saved.—By *Felda C. Lund.*

A Snow Plow for the Family Car

THIS winter has been one of heavy snow. Many localities have been virtually smothered by a blanket of snow made up of successive layers, with hardly sufficient intervals between snowfalls to clear paths and roads through the heavy drifts. So the inhabitants of those regions have come to appreciate the importance of clear roads, and they are manifesting real and keen interest in anything that can be used in combatting snow and ice.



The detachable snow-plow and how it operates against heavy snow-drifts

And here is a timely invention, and one that appears practical. It is a snow plow that can be attached to the conventional family car, and serves to plow a way through heavy snow. The device really consists of three plows, a big center one and two smaller ones on each side and mounted on runners to take up the weight. Thus the snow is cleared from the road in front of the wheels, as well as at the sides. The center or large plow is adjustable independently of the side plows, so that the snow can be removed from the center to any desired depth. By a novel arrangement the center plow can be so adjusted that it can be tilted at any angle found best for the particular job in hand.

The snow plow can be attached or detached from any automobile at short notice. It is held on the frame, and therefore does not weaken the radiator or other relatively frail members of the automobile.

New British Shock-Shifter Hub

AN invention that promises economy in road construction and maintenance and reduction in the cost of running vehicles, and whose use with solid tires is said to make them as good as pneumatics, is now attracting attention in Great Britain through the hearings on the inventor's application for an extension of his patent. The new device is called a shock-shifter hub, and was invented by J. John Muir prior to the war. The outbreak of hostilities prevented its exploitation, and for this reason the inventor has recently applied for a seven years' extension.

From details supplied by Mr. Muir it appears that the shock shifter consists of a fluid "steel ring" of superimposed steel balls which give an all but liquid bearing to the axle. Between the hub proper and the body of the wheel an annular chamber is interposed containing a number of steel balls which nearly, but not quite, fill the chamber. When the vehicle is stationary the hub rests on the balls at the bottom of the chamber; when the vehicle is in motion centrifugal action occurs, and the balls become disposed around the annular space, their symmetry being displaced when the wheel is given an upward movement due to road shock. It is in this change of motion of the balls that the greater part of the shock becomes absorbed and nullified, with the result that there is less damage to roads and much more comfortable traveling.

Gen. Searle, formerly chief engineer of the London General Omnibus Co., stated at the hearings that the invention had been given a 12-months' trial by the omnibus company with good results.

New Type of British Airplane Engine

THE report comes from Manchester that tests have been completed there by Capt. William P. Durtnall of a new type of airplane engine which will be silent, and from which the danger of fire in the air has been removed. The tests were made on a converted engine that had been previously operated on the Otto cycle system.

At present the exhaust pressure of the gases is very high in ordinary airplane engines, producing considerable noise. Under the system used in the Bowles and Durtnall engine, the exhaust gases leave the engine at ½-pound pressure per square inch, which results in "silent" operation. With so great a reduction of the temperature, it is claimed to be impossible to get a flame from the exhaust in any circumstances. The further claim is made that cheap heavy crude oil can be used and that full power can be produced at altitudes up to 20,000 feet.

A large company of Newcastle is reported to have secured the rights of these engine improvements for use on the large power internal combustion railway locomotives which it is now building.

Rear view of a water sled equipped with airplane engine

Yachting at Express Train Speed

A VERY definite demand for extreme speed on the part of certain power boating enthusiasts has brought forth many interesting types of hydroplanes or water sleds, both here and abroad. And with the termination of aerial hostilities and the unloading of airplane motors that were left in the hands of shrunken military forces, it is not surprising to find such motors making their way into strange motor boats.

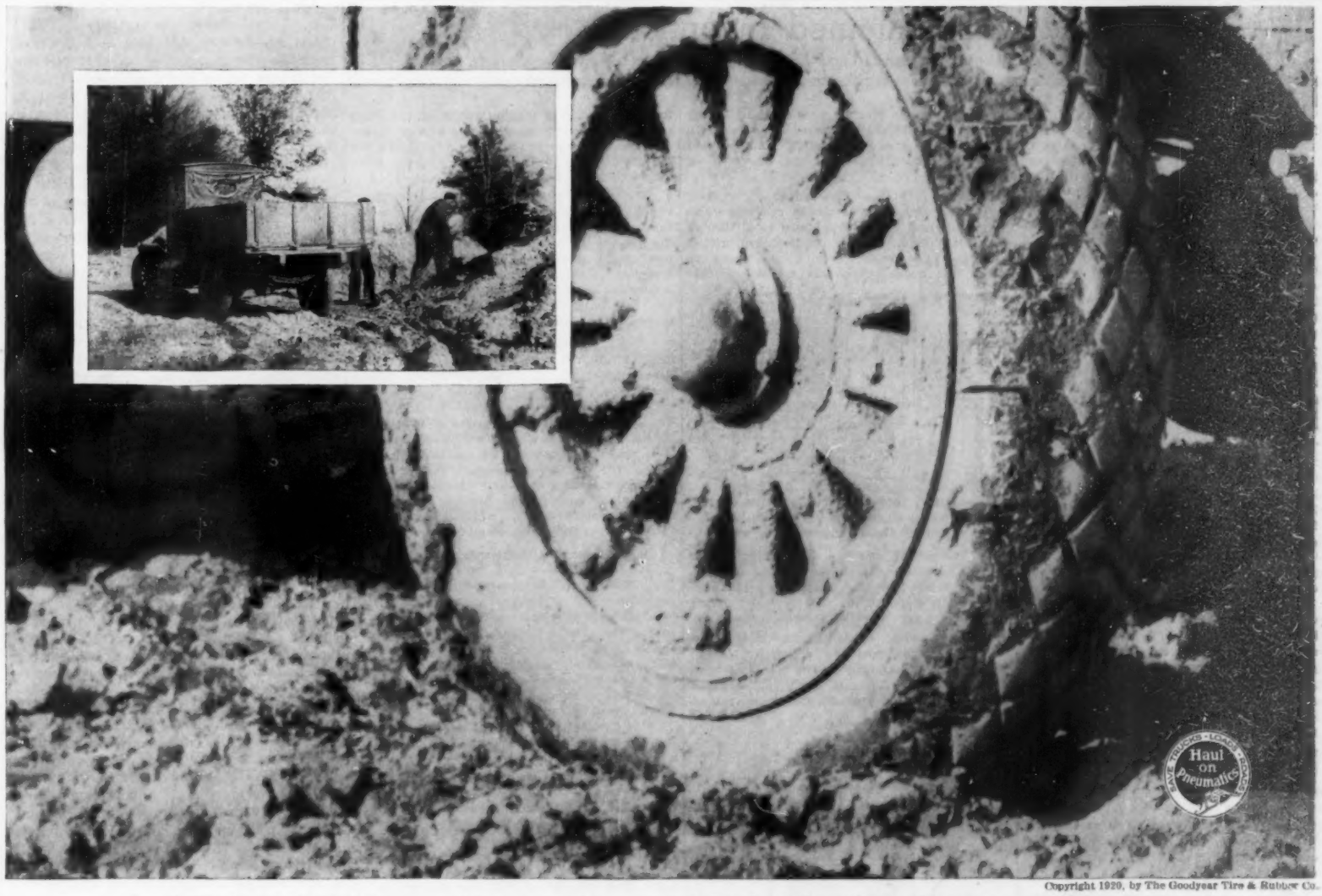
A typical case is the water sled shown in the accompanying illustration. This craft is 30 feet long with a 10-foot beam, and draws 3 inches of water. It is driven by a 400-horse-power, twelve-cylinder airplane engine, which drives a large airplane propeller. With ten passengers and riding on smooth water, this craft makes 50 miles per hour with ease.

No more comfortable means of traveling could be wished for. The cabin is enclosed and fitted with glass windows on their sides.

Making the Horse Skid-Proof

INVENTORS, particularly those who have worked on anti-slipping devices for horses, recently had a real opportunity to demonstrate the merits of their inventions before a competent board. The Horse's Aid Society of New York City judged the merits of various non-slipping attachments on the frozen lake in Central Park. William Watson, a fireman of Jersey City, N. J., received considerable praise for the excellent non-slipping attachment which he invented and entered in the contest. His device is shown in the accompanying illustration, and is practically self-explanatory. It consists of two members held together like a pair of pliers, and provided with clamping members and studs, so as to fit the hoof.

Readily attachable non-skid device for horses



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"PNEUMATIC tires enable us to use a motor truck—otherwise only teams could haul our steel girders and supplies to bridge construction over soft fields. Your Goodyear Cords save truck, time, labor—enable us to do work otherwise impossible."—O. E. Nichols, Superintendent of Construction, Rochester Bridge Company, Rochester, Ind.

THIS vivid word picture describes one of innumerable instances in which pneumatic tires now make the employment of motor trucks possible as well as profitable.

Men and industries find that the tractive, cushioning, easy-rolling pneumatics free them from tedious team hauling by freeing trucks of the handicaps imposed by solid tires.

The present rapid adoption of the pneumatic truck tire has its basis in the high development of Goodyear Cord construction, begun years ago by Goodyear.

This method of manufacture, combining extreme resilience and toughness, is the foundation of every virtue of the pneumatics by which they multiply the utility and economy of motor trucks.

Goodyear has not only worked out Goodyear Cord construction but also has pioneered its application in heavy transport duty with pneumatic-shod fleets—the Akron-to-Boston Express, the Akron-to-Cleveland Freight Line, the Goodyear Heights Busses; and similar undertakings.

Now very complete cost data, developed by these pioneer caravans, and detailing the economy of pneumatics in comparison with solid tires, can be obtained by writing to The Goodyear Tire & Rubber Company, at Akron, Ohio.

GOODYEAR
CORD TIRES

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

AEROPLANE.—J. M. FUNK, address Tom Smurr, Ottawa, Ill. The invention relates to the stabilizing and controlling of aeroplanes by means additional to ailerons and the like. An object of the invention is to provide a vane or plane element and controlling means therefor adapted to automatically function upon a stoppage of the propeller or upon a material decrease of the air current generated thereby, due to the stoppage of the motor or the encountering of an air-pocket, a cross current, "upcomer" or "downcomer" or other abnormal atmospheric condition.

AERIAL VESSEL.—A. and J. DEAK, 57 Ten Eyck St., Brooklyn, N. Y. Among the objects of the invention is to provide a device for use in aerial vessels whereby sudden dropping, in case the motor stops, is entirely prevented, and the pilot is enabled to safely guide the vessel to a suitable landing. Another object is to prevent aerial vessels from capsizing in case the motor stops, and to balance the vessel in case of a rapid descent.

AERIAL BOMB.—J. J. MCINTYRE, 91 St. Marks Place, Brooklyn, N. Y. The object of the invention is to provide an aerial bomb intended to be dropped from an aroplan, or dirigible, and arranged to permit of safely handling the bomb to insure positive explosion thereof as soon as it strikes an object or at the expiration of a predetermined period of time. Another object is to cause the casing of the bomb to break up into numerous small pieces and thus act similarly to shrapnel.

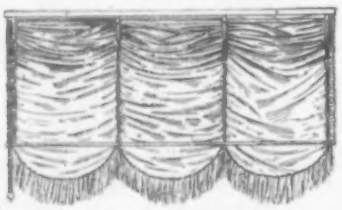
PARACHUTE AND LAUNCHING DEVICE FOR AEROPLANES.—J. L. PFLUEGER, New Orleans, La. The invention relates more particularly to safety devices whereby an aviator may, in case of accident, or loss of control, descend in comparative safety apart from the aeroplane itself; the primary object is the provision of a parachute and launching device, the structure of which will enable an aviator to entirely free himself from the aeroplane along with the parachute so as to avoid all danger of fouling the parachute upon the machine structure.

Pertaining to Apparel

SHIRT.—J. HURWITZ, 148 W. 23rd St., c/o Hurwitz & Robbins, New York, N. Y. The object of this invention is to provide a shirt of the negligée type whereby the worn out or torn portions can be conveniently removed, at the same time, however, displaying unusued duplicate portions thus permitting the owner to practically use the shirt twice the length of time of an ordinary shirt of the same type.

Of General Interest

CURTAIN HANGER.—W. ANDRESS and C. F. NEUMANN, 19 Mickle St., Corona, L. I., N. Y. Among the principal objects of the invention are to dispose the window shades known in the trade as "cloud shades" in par-



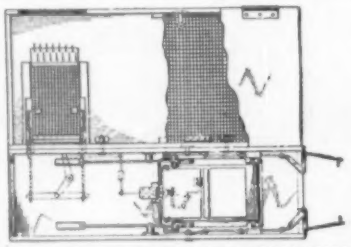
AN ELEVATION SHOWING THE INSIDE OF A WINDOW WITH SHADE PARTLY RAISED

allel elevated positions without changing the initial arrangement of the folds, to perfectly arrange the folds by distributing the supporting strain of the folded portions, and to simplify the construction and facilitate the handling of shades of the character mentioned.

KEY RING HOLDER.—J. A. EICHSTEDT, 1154 1st Ave., Akron, Ohio. This invention relates more particularly to a key ring holder formed from a single strip of material adapted to be locked to a person's belt and to a key ring by a single fastening element. An object of the invention is to provide a key ring holder which may be carried on a person's belt.

BOOK HOLDER.—T. W. GEROULD, 216 Pleasant St., Athens, Pa. The invention has for its object to provide a device especially adapted for use in holding books in open position as, for instance, music books, to be held open on the rack of a piano, wherein the book is so held that the pages exposed are in approximately the same plane and without danger of the loosening of the leaves or of the book.

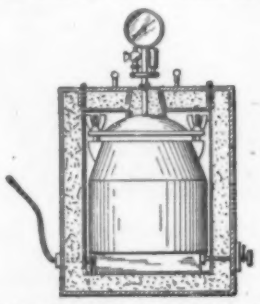
ANIMAL TRAP.—J. D. MILLER, L. B. 769, San Diego, Cal. The invention relates to animal traps and more particularly to a trap of the type having a trap compartment and a holding compartment leading therefrom to which the animal may find access, together



A PLAN VIEW, TOP OF TRAPPING COMPARTMENT BEING REMOVED, AND PARTS OF COVER IN HOLDING COMPARTMENT BROKEN AWAY

with self-setting means. The object is to provide means to detach the holding compartment from the trapping compartment for convenience in disposing of the trapped animals.

COOKER.—H. B. DUTTON, 1070 W. 7th St., Des Moines, Iowa. An important object of the invention is to provide a cooker or canner having extreme economy and low cost of operation. A further bject is to provide a device embodying a steam pressure cooker element ar-



A CENTRAL VERTICAL SECTIONAL VIEW THROUGH THE OUTER HEAT INSULATING CASING, ASSOCIATE ELEMENTS BEING SHOWN IN ELEVATION

ranged within a heat insulating casing, together with means arranged within the heat insulating casing for heating the cooker. A further object is to provide a device which is easy to operate, and neat in appearance.

BOTTLE STOPPER.—F. C. BUTLER, c/o A. B. Snook, Trust Bldg., Edgewater, N. J. This invention has for its object the provision of a construction wherein the sticking of the stopper is prevented to an appreciable extent. Another object is the provision of a stopper for ground glass bottles wherein the contact surface is reduced in area and thereby presenting means whereby sticking is prevented through a tight connection, the reduced area presenting such a structure as to act as a guide as well as a contact surface.

Hardware and Tools

WRENCH.—L. A. CROMBIE, Hicksville, N. Y. The invention relates to wrenches known as the adjustable jaw type. It is the primary object of the invention to provide a wrench in which adjustments of the jaws may be made by manipulations thereof with one hand

A VIEW PARTLY IN SECTION, PARTLY ELEVATION, SHOWING THE JAWS IN CLOSED POSITION

only, thus making the device especially adapted for use by persons who have temporarily or permanently lost the use of one hand. A further object is to provide for minute adjustments within the extreme limits. On the free end of the device is provided a screwdriver.

DIE FOR MAKING DOUBLE-ENDED RIVETS.—W. L. CURTIS, 23 Newman St., Springfield, Mass. Among the principal objects which the invention has in view are to reduce the time factor in making rivets of the character mentioned, to cheapen the cost of manufacture, to shape the rivets to facilitate the heading thereof and to secure greater accuracy in shapes imparted to the rivets.

AUTOMATIC TOPPING HEAD.—H. SPENCE, 168 Bergen Ave., Kearney, N. J. This invention relates to metal working tools. Among the objects is to provide a head or attachment for a drill press with means within or associated therewith for operating the taps in a forward or positive direction at a low speed and for returning it after the hole has been tapped at a high speed.

Heating and Lighting

KNOCKDOWN STOVE.—W. H. ROBINSON, Schenectady, N. Y. This invention relates particularly to stoves adapted for use by camping parties and the like, the object being to porvide a stove the parts of which may be readily knocked down to occupy the minimum space in transportation or storage, and in which the parts when assembled are held together merely by their inter-engagement without the use of bolts, screws, or other securing members and in which the parts are formed by cutting and stamping sheet metal.

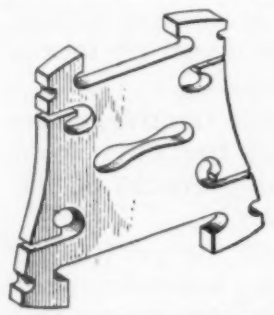
Machines and Mechanical Devices

FRUIT DRIER.—A. H. MCINTYRE, Tampa, Fla. The invention relates to a mechanical device for drying freshly washed citrus fruit prior to wrapping and packing. The object is to provide a drier arranged to effectively dry the fruit by subjecting it to a current of air while alternately moving the fruit bodily along for a short distance and then rolling it down an incline a number of times for the air to reach every portion of the fruit's surface. This is accomplished without danger of bruising the fruit.

REINFORCED PUMP-CASING.—R. H. ALDRICH, Allentown, Pa. The object of the invention is to provide a cast metal pump casing which is reinforced at the bridge piece intermediate adjacent entrance openings of the valve chamber. Another object is to provide a valve chamber of the proper area to accommodate two or more valves and at the same time permit of reducing the width of the valve chamber and consequently that of the pump to a minimum.

Musical Devices

VIOLIN SOUND POST.—R. E. HARDEE, Savanah, Ga. The invention relates particularly to a sound post for violins, etc., which will replace the usual sound post and bass bar, the object being the provision of a means



A DETAILED PERSPECTIVE VIEW OF THE INVENTION

of connection between the top and back of the instrument, which is so constructed and arranged as to more perfectly transmit vibrations than is possible with the connections heretofore proposed.

We wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject-matter involved, or of the specialized, technical or scientific knowledge required therefor.

We also have associates throughout the world, who assist in the prosecution of patent and trade-mark applications filed in all countries foreign to the United States.

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Lightening the Stevedore's Load

(*Continued from page 267*)

direction—from a ship to a dock floor, or from the pier to the ship. Also it will run the trucks up or down with equal facility; so that no great attention need be paid to whether the dock or the deck is the higher. We show two views of this device, one loaded and one idle, to give an idea of what the belt looks like.

About eight loads per minute can be hauled by means of the slung gang-plank shown in the lower pictures. With the conveyor, the truck travels as fast as a man can comfortably walk, and there is no pause at the bottom of the plank, as the pushers are sufficiently close together to make it unnecessary for the man ever to wait for them to engage his truck. And the conveyor can elevate a solid stream of trucks, not requiring that one stevedore wait till his predecessor has reached the top before going aboard the conveyor with his own truck.

When the conveyor is not in use it is picked up by the crane and deposited on a support at the front end of the barge or ship. A flexible cable connects the motor in the conveyor with the generator in the barge-house or engine-room, and is disconnected when the conveyor is to be placed on the supports.

Navigating Ships in Trains

(*Continued from page 270*)

motor can be worked at five different speeds. The electric current is received from the "Dawn" through a flexible cable which is of the well-known concentric type, *i. e.*, an outer and an inner conductor shielded by insulating material—the outer conductor being again insulated and protected by a jute covering. The cable carries current at 220 volts, is slightly less than one inch in diameter, and weighs about half a pound per foot. The cable runs from a reel at the bow of the "Dawn" up over an elevated pulley and thence 60 feet away to the stern of the "New Era," where it passes through a bronze bell-mouthed casting and, a little forward, is plugged into the local circuit. Immediately after coming aboard, the conductor is secured by a line which is led to a nearby cleat—thus taking the pull that otherwise would come at the circuit plug.

Besides the connection to the electric motor, provision is made for linking the circuit, through a proper resistance, to a storage battery composed of 60 cells which, when fully charged, can deliver current at something over 120 volts. The battery has sufficient capacity, when the "New Era" is disconnected from her normal source of power, to give her a speed of approximately 6 miles an hour for a period of 2½ hours. Thus, the cells, which are intended to furnish energy for lighting, heating, cooking, etc., make the "New Era" self-sufficient in case of any slight breakdown on the "Dawn," and enable her to proceed alone when for some reason it is desirable to separate the craft. The "New Era" is controlled either from the wheel house or from a station immediately above on deck. It has been found entirely practicable to regulate the speeds of the two vessels so that the power cable hangs slack between them at all times. For the purpose of facilitating vocal communication, the yachts are joined by a telephone circuit.

During the better part of November of last year the "Dawn" and the "New Era" made an extended trial run from New York City up the Hudson and thence by the State Barge Canal to Schenectady, returning to the metropolis near the end of the month. Weather conditions for much of the time were stormy and, while robbing the trip of some of its pleasure, served to put the system to a pretty rigorous test. The little vessels met every emergency in a thoroughly satisfactory manner. It is now Mr. Donnelly's intention to equip the "Dawn" with a larger

(*Continued on page 286*)

America's Chief Industrial Need

America's chief industrial need at present is not only increased production—but increased QUALITY in its increased production. It is vital not only in our domestic markets, but also in the world's markets overseas where need of goods has flung the gates open for a time, but only QUALITY of goods can prop the gates open for all time.

To the manufacturer seeking to increase both the quality and quantity of production, S K F's foresight in establishing a scientific research and engineering organization for the study of bearing application and design is of value, we believe. For it enables the manufacturer to place his bearing problems in the hands of this technical staff with the assurance that a sincere attempt will be made to solve them.

This scientific, specialized engineering service is offered not only to those manufacturers who have already accepted the bearings produced by S K F as the highest type of anti-friction device, but to all others who recognize both the individual's and the nation's need of higher quality in our increased production.

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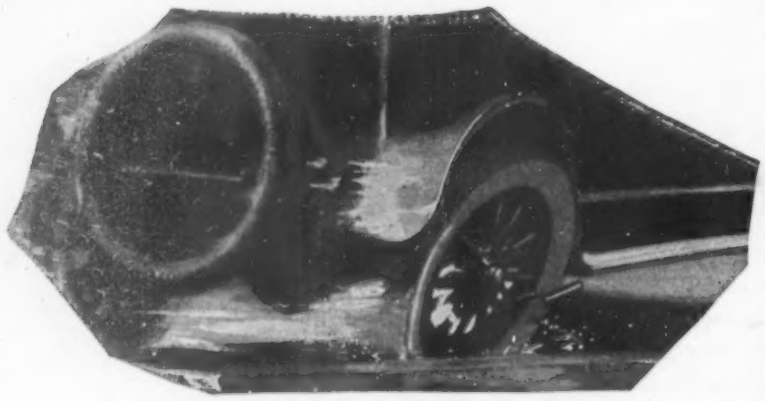
The S K F Research Laboratories where friction problems are solved.

Powrlok in the Rear Axle



PREVENTS SKIDDING

Powrlok at one stroke minimizes skidding—and stops stalling by a simple, time-tried and proven mechanical principle, which *automatically* distributes the power to the rear wheels as it should be—in direct proportion to the traction or hold which they have on the ground—instead of in indirect proportion as the ordinary differential does.

Powrlok has been in actual use for over five years. Over sixty manufacturers of cars, trucks, tractors and industrial trucks now use it as standard equipment.

Complete information is given in our new booklet—"More Than a Differential." Ask for it. Specify Powrlok in the rear axle when you buy any car, truck or tractor.

THE POWRLOK COMPANY, 1107 East 152nd St., CLEVELAND, OHIO

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If so, protect your interests and the interests of your customers by registering your trademarks abroad. Otherwise your trademarks may be acquired by competitors with the result that your customers will continue to purchase goods bearing your trademarks, but they will buy from others and not from you. Your foreign business is not an asset unless your trademarks have been registered.

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Navigating Ships in Trains

(*Continued from page 284*)

internal combustion engine capable of developing from 80 to 100 horse-power, and it is his purpose likewise to remove her original generator and substitute a later pattern of 50 kilowatts.

The performance of these electrically-propelled yachts—pioneers in this field of marine transportation—show how admirably the system is suited to the operation of canal and river craft. Again, upon an enlarged scale, the method may be employed for traffic on our bay, sound and lake routes. Mr. Donnelly has developed some exceedingly interesting data relating to coastal runs in comparatively sheltered waters for distances up to a hundred miles, for example. He makes a direct comparison between a single steam freighter of 2,000 tons cargo capacity and an electrically-driven multiple-unit fleet of one power boat and two freight carriers, together able to transport trains of loaded cars holding a total of 2,000 tons of commodities—both the steamship and the multiple-unit group to have a speed of 10 knots an hour.

His figures show that the 3-unit electrically-driven vessels could be built for about 55 per cent of the cost of the steam freighter. Besides, he says that the flotilla would require at full speed only 83 per cent of the power needed for the single cargo vessel; and, during a month's time, by reason of the ability to make quick turn-arounds, the triple-unit flotilla would cover more than double the ton-mileage of the single 2,000-ton steamer! By reason of this much greater activity, the income on the electrified group would be 116 per cent greater than that of the competing cargo carrier, while, because of certain operating economies, the power boat and her two self-propelled consorts would produce net earnings fully 140 per cent larger than those possible with the lone craft.

Where the service would constitute a link between railway terminals, with the ultimate destination of the goods beyond the delivery port, by transporting loaded cars Mr. Donnelly would avoid breaking cargo and rehandling, and in this way make it feasible for the cars to be taken aboard at one point and landed promptly at another—going forward immediately by rail. If the water gap were 100 miles between the receiving and the delivery railway docks, in either case the run by steamship or multiple-unit flotilla would take 10 hours, but the steamer would lie in port 14 hours before starting back, while the electrified boats could be got off again in about 45 minutes. In other words, the 3-unit fleet would be able to operate profitably for 648 hours a month against the single ship's 300 hours!

For seagoing work, there is every reason for the adoption of the multiple-unit idea, for ultimate economy hinges upon separating the primary source of power from the dependent craft so that the central-station ship can be quickly dispatched with another convoy. As is well known, deep-sea towing has for the most part been restricted to coastwise service where it would be possible to slip into the nearest haven in time of storm. This has been the practice mainly because of fear of snapping tow lines and the difficulties of handling a string of vessels wholly lacking powers of self-propulsion. But if these boats were made automotive by the distribution of electricity, then the dominating part of a tractive cable would disappear, and, at the same time, the binding tie need not be of the same character of weight—nor would it be necessary to provide expensive towing machines, etc.

Instead, we should see a sturdy master ship, equipped with economical Diesel engines for the operation of the dynamos, and the separate members of the fleet fitted with electric motors and screws best suited to propel them according to their respective models and displacements. None would constitute a drag upon any of the others, nor pull at cross purposes when contending with opposing waves. In boisterous weather, the fleet could forge steadily and confidently forward—the energized vessels preceding or following the parent ship as occasion demanded. By equipping the dependent boats with storage batteries, they could be made self-driving for a while if the power cable broke or it should be desired to drop a unit en route for the purpose of making a certain port—the rest of the fleet going on to a point beyond.

The X-Ray in the Shop

(*Continued from page 271*)

X-ray tube, in a lead-covered case, with a fan at one end and an exit at the other, for ventilation. There is a hole in the bottom of this section, directly under the tube, which permits the rays to fall directly upon the mica under test. The lower section contains a track and truck with a fluorescent screen upon which the trays of mica are set, the trays being about two feet long and a foot wide, consisting of a light wooden frame stretched with white cloth.

This arrangement is necessary so that the observer can move the trays from her cabinet, without moving from her seat. There is a lead shutter, which is connected to the end of the truck, and which closes when the tray is moved over, shutting off the rays from above, which would otherwise discolor the glass of the mirror. The mirror in question is set at a 45-degree angle, about a foot under the tray, and so placed that it reflects the image of the mica directly through the glass in front of the observer.

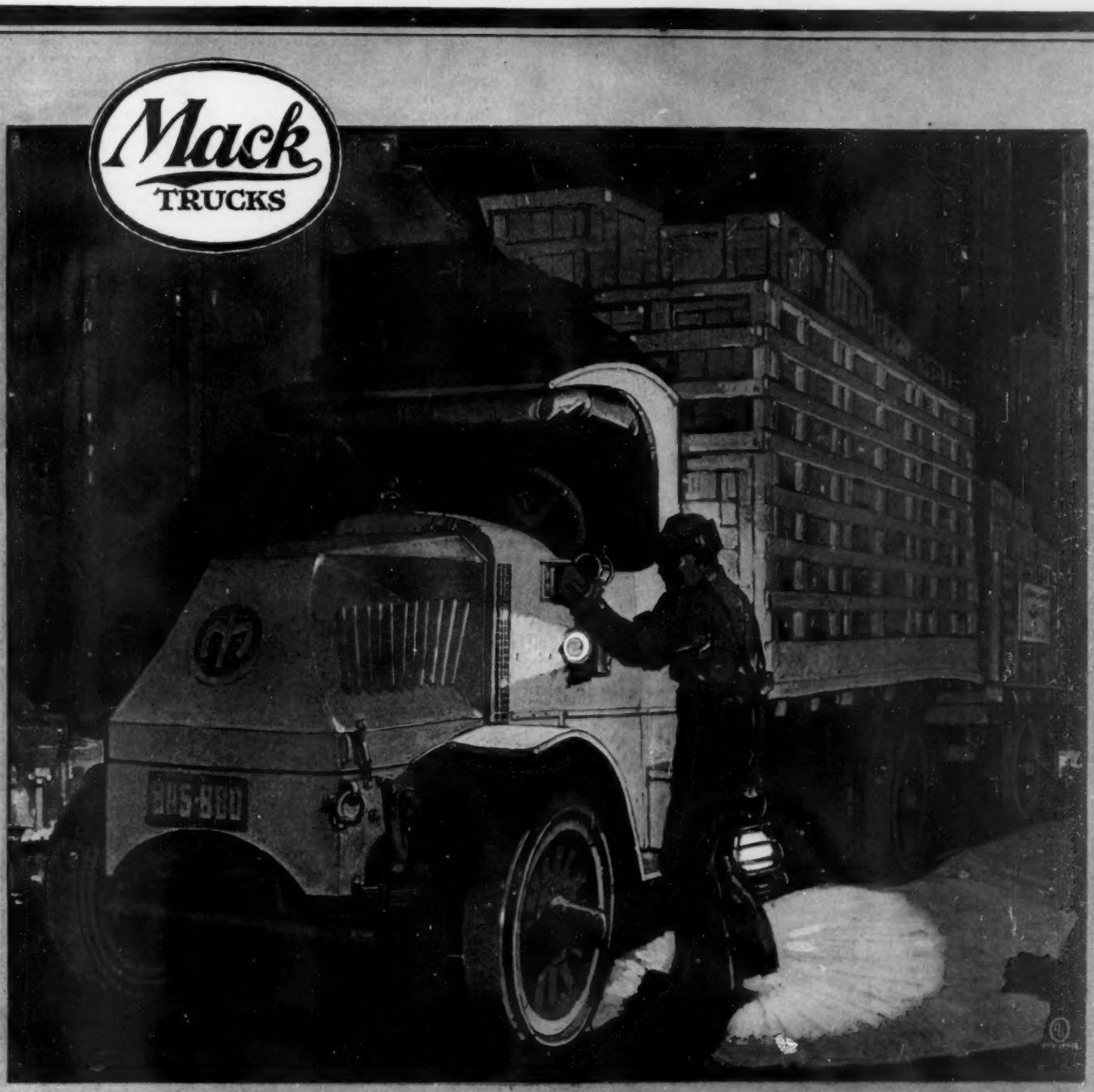
The mica to be tested is placed on the trays, which are put on their track through a lead-covered door in the front of the section beneath the tube, and the door closes by means of counterweights. The aperture between the tube and the trays is then opened, and the observer has before her the X-ray reflection of the mica. This reflection has the general appearance of an X-ray photograph. The solid parts of the mica strips appear light gray, the spots of lesser density being of a lighter shade. The absence of comparatively few mils of mica will show up in the form of light spots, which increase in brightness in proportion to the decrease in the density of the mica object. Foreign objects, such as pins and bits of wire, no matter how fine, tinfoil, etc., are a jet black, with sharply defined outlines. In fact, the smallest piece of metal or wire shows with a distinctness that reduces the chances of its remaining undetected to almost an impossibility. The same is true of weak or thin spots in the mica itself. The trays themselves are equipped with clearly marked scales, one on the side and the other on the bottom, as it appears in the reflection, so that by reading the figures it is possible for the observer to tell anyone outside exactly which mica piece is faulty, and indicate the location of the fault in the piece.

The only limit to the number of strips that can be tested is the speed with which the trays can be loaded and set on their tracks.

The result is a test that cannot fail to show instantly any piece of mica that is faulty for any reason whatsoever, and thus assures the electrical company in question that all the mica that is sent out is as nearly perfect as is possible, from an insulation standpoint. A further item of interest is that one of the tubes used in this test has an actual running time of one thousand hours to its credit, which is nearly, if not, the record for life in an X-ray tube.

American Tennis Shoes in Chile

THE popularity of tennis in Chile has led to a steady increase in the sale of rubber-soled shoes, and the English product, with a leather upper, is yielding to the lighter American canvas footwear.



Again, "Performance Counts"

"....Reaching Moneta at midnight (after more than 500 record-breaking miles under heavy load) one of the two Mack Trucks hooked onto a trailer and the truck and trailer delivered 17½ tons of tomatoes by next morning to a cannery 25 miles away."—*News Service Bureau, International Motor Co.*

A TYPICAL long-haul Mack performance! Where the going is continuous and the toil hardest—there you will find Mack Trucks pushing their work through on rigid schedules. The Mack is a selected truck—a self-sufficient unit engineered to the very peak of mechanical excellence. Hence the uniformly striking character of Mack performance. *Capacities 1½ tons to 7½ tons.*

INTERNATIONAL MOTOR COMPANY
NEW YORK

"PERFORMANCE COUNTS"

ON RARE OCCASIONS, WHEN THERE WERE NO SHOES TO BE PEGGED, W.L. DOUGLAS WOULD GO TO A NEARBY MILL POND AND FISH FOR AN HOUR OR TWO. THIS WAS PRACTICALLY THE ONLY OPPORTUNITY HE EVER HAD TO PLAY

W. L. DOUGLAS NAME AND THE RETAIL PRICE IS PLAINLY STAMPED ON THE SOLES OF EVERY PAIR OF SHOES BEFORE THEY LEAVE THE FACTORY. THIS PROTECTS THE WEARER AGAINST HIGH PRICES AND UNREASONABLE PROFITS

FOR MEN AND WOMEN

W. L. DOUGLAS

"THE SHOE THAT HOLDS ITS SHAPE"

$7.00 $8.00 $9.00 & $10.00 SHOES

BOYS' SHOES $4.50 $5.00 $5.50

W. L. Douglas shoes are sold through 107 of our own stores direct to the wearer at one profit. All middlemen's and manufacturing profits are eliminated. W. L. Douglas $9.00 and $10.00 shoes are absolutely the best shoe values for the money in this country. W. L. Douglas name and the retail price stamped on the bottom guarantees the best shoes in style, comfort and service that can be produced for the price.

Stamping the price on every pair of shoes as a protection against high prices and unreasonable profits is only one example of the constant endeavor of W. L. Douglas to protect his customers. W. L. Douglas name on shoes is his pledge that they are the best in materials, workmanship and style possible to produce at the price. Into every pair go the results of sixty-seven years experience in making shoes, dating back to the time when W. L. Douglas was a lad of seven, pegging shoes.

The quality of W. L. Douglas product is guaranteed by more than 40 years experience in making fine shoes. The smart styles are the leaders in the fashion centers of America. They are made in a well-equipped factory at Brockton, Mass., by the highest paid, skilled shoemakers, under the direction and supervision of experienced men, all working with an honest determination to make the best shoes for the price that money can buy. The retail prices are the same everywhere. They cost no more in San Francisco than they do in New York.

W. L. Douglas shoes are for sale by over 9000 shoe dealers besides our own stores. If your local dealer cannot supply you, take no other make. Order direct from the factory. Send for booklet telling how to order shoes by mail, postage free.

CAUTION.—Insist upon having W. L. Douglas shoes. The name and price is plainly stamped on the sole. If it has been changed or mutilated, BEWARE OF FRAUD.

W. L. Douglas

President W. L. DOUGLAS SHOE COMPANY, 165 SPARK STREET, BROCKTON - - MASS.

Highways Through the Wilderness

(Continued from page 274)

that in February and March can scarcely be descried and in August and September seek to rival the Orinoco's flood, has evolved a model, the fundamental scheme of which is set forth in the following official description of a bridge over a rivulet that in the rainy season is wont to develop torrential proportions:

"Of reinforced concrete, this bridge has an aperture of only 5.2 meters (about 17 feet) and is formed of two abutments of concrete, five beams of steel and one span of concrete. The height of the lower part of the span above the base of the abutment is 4 meters and the total width of the structure is 4.75 meters, including the parapets, each one of which is 30 centimeters (about a foot) in thickness. The beams of steel that support the span are of two classes: three pieces in the form of a U (channel) of 25 centimeters in height and 7 centimeters in flank and two double 'Ts' of 38 centimeters in height and 15 centimeters at base, arranged alternately in such a manner that the first occupy the axis and the heads of the bridge and the second the two intermediate positions; the two central spaces, between the axes of the pieces, being of one meter and the laterals of 1.2 meter. The beams have a total length of 7.3 meters. The span has the following dimensions: 7 meters of length by 4.75 of width by 15 centimeters of thickness, thus giving it a total of approximately five cubic meters. It is reinforced with bars of ¼-inch diameter, arranged with a distance of 10 centimeters (4 inches) between them. The steel beams, as they have been placed by the engineers, are not, as will be seen, of the same form, but they have a resistance amply sufficient for their respective loads. In fact the resistance is much greater than is actually necessary and without counting the parapets, which are provided with bars in the longitudinal direction and so serve as beams of reinforced concrete."

Steam rollers and other standard mechanical apparatus have been employed in the road construction work, while recently the authorities have commenced to use the superficial petrolization process for laying the dust and counteracting the impairment of the roadbed by the rapidly increasing automobile traffic.

The equipment of the highways has brought to the fore another characteristic and interesting Venezuelan institution—the "peones camineros," or road workmen—who fulfill a dual function in the task which they assume when a road or section is completed, that of attending to, or assisting in, its upkeep or repair and guarding against violation of the regulations laid down for its use by the public and otherwise policing a stretch that is of three kilometers upon macadam roads and two kilometers upon natural dirt roads. The "peones camineros" represent but another and latter-day application to public service of the marvelously faithful, intelligent and efficient common labor of the country.

Had the new road system been inspired and carried into execution by American builders for the advancement of their own people's interests, they could scarcely have served more thoroughly the purposes of American commerce. From the outset these roads have operated to strengthen this country's position as a producer and exporter of automobiles. In the initial stages of the great work, one of the most popular of the Detroit plants was called upon by the Venezuelan Government to produce a special type of small combination car and truck, of a half-ton capacity, which proved to be of special utility not only for the transportation of tools, small bridge parts and minor loads of broken stone, cement, sand and the like, but also for the movement of inspectors, construction officials

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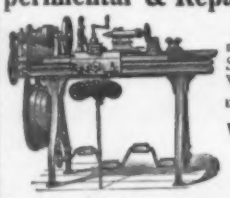

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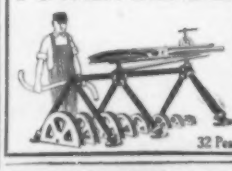

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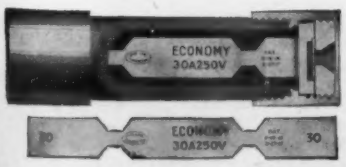

and employees, particularly over sections where little headway had been made in building.

Then when the more important routes were completed and thrown open to traffic, the importation into Venezuela of motor-cars, almost without a single exception of American make, leaped ahead and from no entries in the year 1910, imports of only 6,330 kilograms, valued at $9,200 in 1911, and 193,101 kilograms, valued at $122,151, in 1912, the movement forged ahead to 964,643 kilograms, valued at $422,226, in 1916, and in the seven years from 1910 to 1917, totaled 3,049,812 kilograms, valued at $1,579,478. Thus a vital public improvement, undertaken by the Venezuelan Government, operated primarily to establish an altogether new market for one of the chief industrial products of the United States. Yet despite the fact that the capital city of Caracas, with its population of 100,000 boasts 1,000 automobiles, or one car for every one hundred citizens, relatively few motor-trucks are to be seen there or elsewhere in Venezuela.

Nevertheless, it requires neither seer nor prophet to foresee positively unlimited opportunities throughout the land of Bolivar for every kind and class of American manufactures, from agricultural, mining and factory machinery to the slightest merchandise, opening up directly as the result of the building and extension of the Venezuelan highway system. And as a means of transporting those manufactures from ship's side to interior communities, some of them Spanish colonial settlements that have flourished for almost four hundred years but that until now have not known American importations, there is only one logical and available factor—the American motor-truck.

Cutting Out a Railroad Hazard

(Continued from page 275)

It would never do to have it so that a broken hose-coupling would render it impossible to apply the brakes on all the cars behind it. It is therefore necessary that the pressure of the air hold the brakes *away* from the wheels, and that the removal of the pressure *apply* the brakes—until this mode of operation was substituted for the more natural one, the air-brake was a joke idea, with no chance of acceptance. But with a leaky coupling, the air escaping from the train pipe may be sufficient to allow the brakes to creep until they are in contact with the wheels and thus exert an added drag upon the locomotive. Even worse may follow if the weakened hose burst while the train is in full motion. This would bring about a vigorous emergency application of the brakes, tending to lock the trucks, and that might invite the buckling up of the train and possibly a disaster. There are likewise seasonal conditions which impair the hose connections. Frost will make these commonly flexible conduits so stiff that hand coupling and uncoupling is wellnigh out of the question, and, if accomplished, is pretty sure to damage the hose. Further, because these swaying loops are rigid and will not give to the movement of the train, the vibration is focused at the couplings, and these open and permit either air or steam to escape. By reason of this, a locomotive cannot maintain a sufficient air pressure throughout a long train to have the brakes under proper control. The only alternative, in the name of safety, is to haul fewer cars in the wintertime. With a given number of engines available this means a serious reduction in freight transportation.

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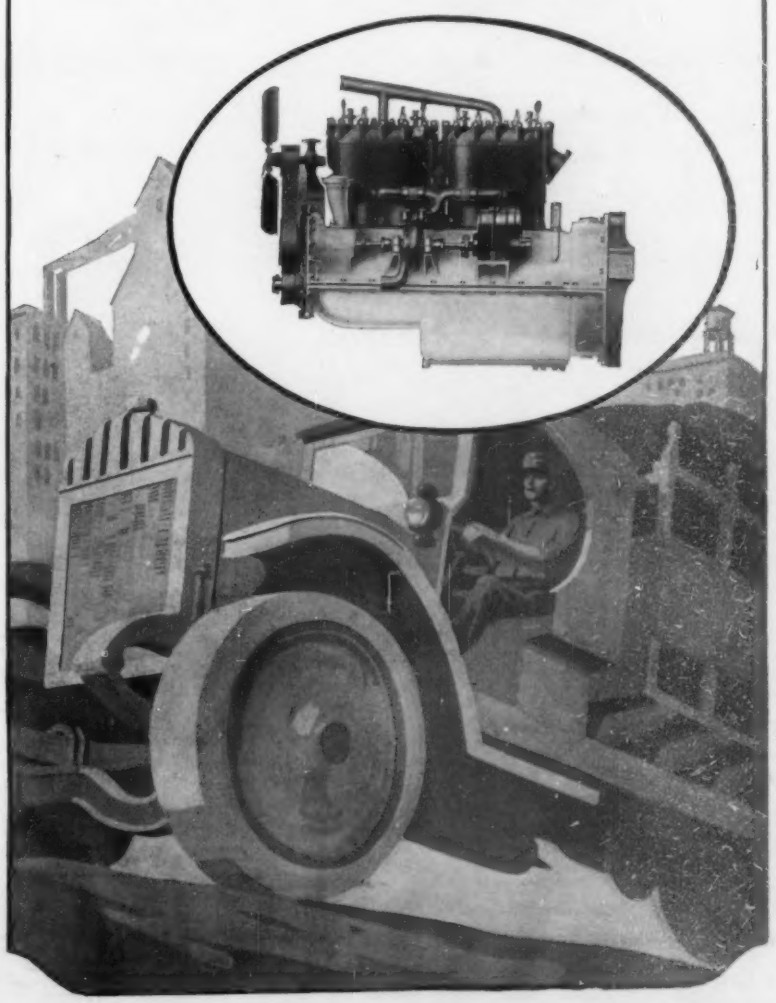

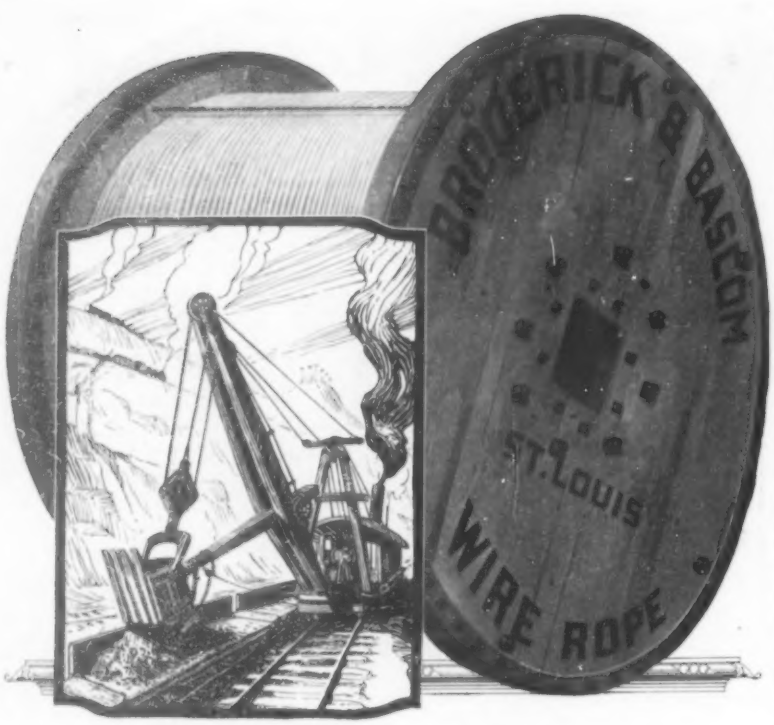

Wire Rope at Panama

The value of wire rope in constructing the great ditch to connect east and west at Panama can hardly be overestimated. Not only were the powerful "muscles" of the giant shovels and material handling cranes wire rope, but a big factor in the disposition of immense quantities of soil and rock was also wire rope.

To unload the "spoils trains", steel plows were hauled from end to end by steel cable, pushing the waste material off one side. So great was the friction on the cable that smoke was usually seen at intervals along the top of the train where the steel cable was cutting its way into immense boulders picked up by the powerful shovels.

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hood of 9,000,000 pieces. At the present prices, this entails a yearly outlay of nearly $10,500,000. The adoption of the connector would double if not treble the endurance of these flexible links. Again the extra pumping required on one locomotive to maintain a sufficient pressure of air against a fairly common leakage calls for the consumption of anywhere from 100 to 300 pounds of coal an hour. With tens of thousands of engines actively engaged it is evident that the price to be paid for this wastage must run into millions of dollars every twelvemonth.

Grasping some of the operative benefits and savings to be effected by a satisfactory automatic connector, Joseph Robinson, about twelve years ago, then living in Salem, Oregon, was encouraged by an acquaintance, a brakeman, to attempt to improve the coupling of the air-brake hose. He quickly grasped the fundamental fact that the thing to do was to devise not an improved coupler but an automatic connector which would eliminate all handwork between cars in making up and in breaking up trains. His first working model brought to light some of the service difficulties to be contended with, and without hesitation he turned to another line of development.

His improvement contained the basic features and principles of a practicable connector. Since then he has so altered and bettered his apparatus that recognition has been won both in the United States and Canada after periods of exacting service. A connector has a number of conditions to meet which present difficulties of divers degree. The connector must maintain a tight union no matter how the cars may lurch or undulate; the contact faces at the air and steam ports must not wear away by friction so as to induce leakage; the gaskets of these joints must not call for frequent replacement; and the two opposite elements of the connector must come together upon any curve or gradient. Of course, the automatic connector would fail of its purpose if it did not function correctly in all kinds of weather. These several prerequisites Mr. Robinson has met cleverly and effectually.

His connector is centered, so far as the end of the supporting car is concerned, by a bracket secured to the under side of the regular coupler. At the lower end of the bracket is carried the head of the device, containing either one or three ports and a corresponding number of hose connections. By means of a tie-rod, a pivot-bar, and a strong buffer spring, the head can respond vertically or horizontally to the movement of the opposite member, while the buffer spring allows for longitudinal play and insures an intimate union once the two heads have effected a junction. The "gathering prongs" alternate, and flare sufficiently so as to engage and to guide the corresponding members on the neighboring car during the coupling process. When interlocked, the port or ports, as the case may be, are perfectly alined.

The air- or steam-tightness at contiguous ports is maintained by opposing molded rubber gaskets which meet just before the metal faces of the connector touch. These gaskets are held in annular recesses which allow for some axial play, and this movement blocks ever so little the flow of the steam or air. The reaction thus provoked forces the gaskets more intimately in contact and seats them firmly against the shoulders of the supporting recesses, in this way causing the steam or air to seal automatically any possible avenues of escape. The greater the pressure the firmer the closure.

In the usual hose-couplings in railway service the metal or composition gaskets employed wear away rapidly and call for frequent renewals. This involves heavy ebpenditures in the course of a year. The rubber gaskets, on the other hand, of the Robinson connector show no signs of deteriora..on after months of rigorous service. There is an absence of that whipping action which is present when the hose hangs between the cars in pendant loops, which thrash about, setting up stresses of a more or less rapidly damaging nature. Even during intensely cold weather—the thermometer registering 58 degrees below zero—the connector stood up to its work without any sign of leakage while at the same time it was found impossible to prevent very serious leakage in the hose of the common installation.

It is not enough that an inventor produce an effective, reliable, and comparatively low-priced device to insure its adoption generally by a great trunk line, because that road inevitably must consider association with the rolling stock of other railways. Therefore, it is essential that a new equipment, no matter what its virtues in its balanced application, must lend itself to ready interchange with other cars and coaches not similarly equipped. This is needful so that the broad adoption of the device may take place gradually and not call for the wholesale scrapping of existing facilities. Mr. Robinson has provided for this transitional period by producing a simple interchange apparatus which is susceptible of speedy adjustment. He thus bridges the gap which might otherwise interfere with introduction of his coupling.

Welding a Lighthouse's Broken Legs

(Continued from page 275)

repair was under discussion, two plans were considered; one for rebuilding the station along the original lines and the other to transfer the present superstructure to a concrete caisson placed close by and secured to the site by piles driven through the bottom of the caisson, the structure in both plans to be heavily riprapped. The cost of repairing the lighthouse by the reconstruction of piling was estimated by the Lighthouse Service at approximately $13,000, while the cost of a completely new structure upon which the present superstructure could have been moved was estimated at approximately $30,000. But bids in both cases were so excessive that it was finally decided to repair the columns of the old structure by welding.

To those who are unfamiliar with the thermit process, it may be explained that thermit is a mixture of aluminum and iron oxide. This mixture can be ignited by means of special ignition powder and on reaction produces superheated liquid steel and slag (aluminum oxide), at a temperature of approximately 5,000 degrees Fahrenheit. This thermit steel is sufficiently hot to melt and dissolve any metal with which it comes in contact; and it amalgamates with it to form a solid homogeneous mass when cool. In making welds by the thermit process the parts to be united are surrounded by a mold and the section heated red hot by means of a special preheater after which the thermit steel is poured into the mold.

The first problem consisted in jacking up the superstructure in order to remove the weight from each column successively, as it was being welded, also to control the allowance for contraction of the weld. As the jacks on hand proved to be too light to support the lighthouse, it was necessary to obtain a 50-ton ratchet-jack from Elizabeth City, N. C., the nearest available place.

The lighthouse was jacked up in the following manner: Two 8-inch square timbers were laid side by side near the corner of the house and across the top of the iron tie-rods which connected the columns together. The jack was set on these timbers and on the head of the jack was placed a wooden structure of ten-inch square timbers which in turn supported an oak cross beam on which 15-inch I-beams supporting the lighthouse, rested. To prevent sideplay when the jack was raised, the structure had to be further

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secured in place by means of chains. The structure above the jack was lifted during each weld so that the upper part of each broken column was raised 3/16 inch as an allowance for contraction.

Having jacked up the column the next step was to cut out about a 1½-inch gap between the broken sections, to allow for the thermit steel to enter. Since in each case the inclination of the lower part of the column had already provided a sufficient gap half way through this section (except in one case where the column had snapped back into place) it was only necessary to drill a series of three small holes by means of an electric drill, and then to knock out with hammer and chisel the metal remaining between the line of holes and the break.

As the columns were hollow with walls 1½ inch thick, the interior spaces were filled with molding and facing sand for a depth of about 3 to 5 feet below the weld, at which point a flange extended horizontally through the column. First it was necessary, however, to remove about two feet of water which had collected in these spaces through rise and fall of the tides, in order to prevent steam from being formed from the heat generated by pouring the molten steel into the weld and thus injuring the mold. This water could not be siphoned out because part of it was below sea level. An oval hole 2 inches wide and 3 inches long was therefore drilled out of the column about 15 inches above the break and the water removed through the hole.

Packing the molding sand inside the column was also a very slow process as the ramming had to be done with a bent rod inserted through the hole without the interior being visible to the operator, whose working facilities were cramped by the peculiar construction of the lighthouse, and consisted at times of only a board suspended by ropes hung from a railing above, as shown in an illustration. When the upper section was rammed up rope was wrapped around the break to prevent escape of sand. Facing sand was inserted for 6 inches above and below the break.

The lighthouse was amply protected from any possibility of catching fire during the thermit reaction by shielding all exposed parts in the house with asbestos sheets. The crucible used for the reaction was supported on a tripod the feet of which rested on the temporary wooden staging. When the crucible was set securely in place over the pouring gate of the mold box the ignition powder which lay on the top of the thermit in the crucible was ignited and the reaction thus started. In spite of the intense heat no injury occurred to the lighthouse. Each weld was allowed ample time to cool, after which the mold box surrounding the weld was dismantled and the thermit steel pouring and heating gates and risers cut off.

It will be noticed in the illustration that the columns were welded together in their bent position, no attempt having been made to straighten them, as it was impossible to force the piles back to their original position, and if the cast iron columns themselves had been bent they would have broken off. The actual time consumed in making the five welds was a little less than three weeks.

The Photostat as an Aid to Research

(*Continued from page 276*)

then be sent to any part of the United States for expert attention. Aside from the identification and listing of these documents for reference purposes, it may well be that some scholar will find material for which he has been hunting for years in connection with some projected book, or he may find an entirely new interest which later will develop into a scholarly production. Without the photostat these rolls would lie idle until some interested scholar sought them out

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"Shamrock IV" and "Vanitie" in Fire Peril

(*Continued from page 277*)

to the call, had made her way up the Sound and after breaking through the heavy ice, got her four-inch streams playing upon the burning yachts and brought the fire under control.

The two steel yachts above mentioned are entirely gutted, and the fire's heat within them has warped the frames and plating to such an extent that they will have to be practically rebuilt. There were also destroyed the 70-foot auxiliary schooner "Vinona," the 80-foot yacht, "Aurora," the 80-foot power yacht, "Aloha," the 65-foot schooner yacht, "Ahma Kola," and also there was partially destroyed the 63-foot house boat "Briny." The destroyed yachts are covered by insurance, and Mr. Jacob assures us that, thanks to the fortunate preservation of the "Shamrock" and "Vanitie," the disaster will in no way interfere with the preparation of these yachts and their participation in the forthcoming races.

What Is a Silo?

(*Continued from page 280*)

cornstalks, from which the ears have been removed.

Silage has been found to be particularly well adapted as a feed for dairy cows, and as a result silos are more numerous on farms devoted to dairying than upon farms of any other kind. In many sections silage has come to be the dairy farmer's main reliance for cow feed in winter.

While silage is an excellent feed, it is not a complete one for dairy stock. It is too bulky and watery and contains too little protein and mineral matter to meet fully the requirements of the dairy cow. It should be combined with some leguminous hay, such as clover, cowpeas, or alfalfa. Cows in full milk require some concentrated feed in addition to hay and silage. The smaller dairy cows eat from 25 to 30 pounds of silage a day, and the larger ones range up to 45 or more pounds.

Silage is not generally fed to horses, although there is no reason why it should not be, if free from mold. Horses are peculiarly susceptible to the effects of molds, and under certain conditions varieties of mold which are deadly poisons to both horses and mules are found on silage. Molds must have air to grow and therefore silage which is packed airtight and fed out rapidly will not become moldy.

No roughage is of more importance to the producer of beef cattle than silage. The value of silage to the beef producer, however, varies according to conditions. It is a great saver of grain when fed to either stock cattle or fattening cattle. It will lessen the grain feeding by one-fourth more than the quantity of grain in the silage. Silage adds variety to the feed and all kinds of stock relish it, and silage creates an appetite for other feeds. Silage is especially beneficial to calves which have just been weaned. They take to this ration more quickly than to dry feed, and there is usually little loss in weight from the weaning.

The use of silage in the winter ration for sheep is increasing, as stockmen have found that their early prejudices against it were unwarranted. Good corn silage furnishes succulence so necessary for the maintenance of the health and vitality of the ewes. In fattening lambs corn silage not only saves hay and grain, but reduces the cost of production and increases the selling value per head when compared with other rations fed. In wintering ewe lambs silage forms an important part of the ration and when fed in conjunction with a good legume hay, it keeps the lambs in good condition and furnishes a good growing ration.

Ecuador Contributes a Wood That Is Lighter than Cork

(*Continued from page 281*)

year. Professor Rowlee has made records showing that the tree increases in diameter about five inches per year, so that a tree of from twenty-four to thirty inches in diameter can be produced in from five to six years.

Balsa wood also has value in the construction of hydro-airplanes, as was demonstrated during the recent war. Wing braces of balsa wood veneered on both sides with fiber board one thirty-second of an inch thick and cut to form a lattice web, are being built for the planes.

When normal conditions are again established, it is expected that the most valuable quality of balsa wood will undoubtedly be the property of insulation against heat and cold, which it possesses in a remarkable high degree because of its cellular texture and the absence of fibers in its structure.

Some Features of the American Motor Boat Show

(*Continued from page 281*)

of the boat at the step and at the stern in contact with the water.

At 70 miles per hour, the question of air resistance is, of course, quite a serious one, and if "Miss America" were certain to be run only in smooth water, it would not be necessary to provide the high bow which she now carries; but in her racing on the waters around the Isle of Wight, she is liable to encounter some choppy seas and, of course, it is necessary to give her plenty of freeboard to negotiate them. It would be an interesting experiment, in a boat of this type, to see how much speed could be added if she were streamlined on true airplane principles. It would not be surprising if under such modification she could reach 80 miles per hour, or even more.

We show another exhibit which is worthy of special mention, namely, the Freeman davit, an entirely new type embodying excellent engineering practice. It has no sliding contacts in its movements inboard or outboard, but turns entirely in journals at the top and bottom of a shaft which is placed at ten degrees from the vertical. The swinging of the davit is accomplished by means of a worm and worm wheel, operated by a crank handle. The inclination of ten degrees of the shaft has the effect that when the tackle has once been drawn taut, the turning of the crank handle and swinging of the davit causes the head of the davit to lift, so that the boat is at once raised clear of its chocks and then swung outboard by the continuous turning of the crank. The whole design is very well worked out. It is rugged and simple and should be singularly free from any liability to get out of order.

Condensation of Fruit Juices

The milk industry is a great one, but so now, with prohibition, is that devoted to fruit juices. The future of the new condensation process in the latter field will be worth watching.